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THE DEVELOPMENT AND RESTRUCTURING OF THE NON-FERROUS METALS INDUSTRIES*

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INTRODUCTION

In the first chapter of this study the main aspects that generated the growth and internationalization of production of the different non-ferrous metals are analysed. Within this context the process of concentration-deconcentration and the formation and evolution of prices are explained. The second chapter attempts to analyse the main causes of the crisis in the non-ferrous metals industries and the impact of the crisis on the main parameters of these industries. In the third chapter the main characteristics of the structure of the non-ferrous metals industries, and the roles played by the different groups of countries (developing, centrally planned economies, developed) in this industry are presented. In the last chapter the major changes taking place in the structure of this industry and the actors involved are analysed.

SUMMARY

The development of the capital goods industry at the end of the nineteenth century and at the beginning of the twentieth century increased the importance of the non-ferrous metals industries. In that period of time the United States had a dominant position in these industries, mainly in the production of nickel, copper and aluminium. After the First World War, mines in Africa operated by companies from developed countries became important suppliers of non-ferrous minerals, and the Second World War increased the number of operations of companies from developed countries (mainly from the United States and England) in developing countries.

In the 1960s the developing countries adopted new policies intended to increase their control over their national resources. These new policies caused the dominant transnational corporations (TNCs) to adopt new strategies. New investments were made mainly in developed countries and in those developing countries where the risk of nationalization was perceived to be minimal. In this period the predominance of the United States in these industries decreased owing to the new policies of developing countries and the major role played by the companies of Japan and Western Europe.

In the 1970s there was a decrease in direct investment by the TNCs in mining and processing in developing countries and an increase in lending. The development of the non-ferrous metals industries from the mid-1970s was affected by the world economic crisis, by changes in the pattern of demand, and by changes in the structure of production of non-ferrous metals. The non-ferrous metals industries are very sensitive to fluctuations in the global economy because of their role in the production of intermediate products. The structure of the main users of non-ferrous products is also changing. These changes are connected with the appearance of new pace-setter technological processes: the process of miniaturization and advances in manufacturing techniques to reduce the amount of metal required, and the use of alternative materials, such as plastics, glass fibers, etc. The structural changes on the supply side, due mainly to the increase in energy prices, have generated technological changes, plant closures, and the redeployment of production capacities toward energy-rich countries.

Consumption of non-ferrous metals increased from 1970 to 1974, decreased between 1974 and 1975, recovered from 1976 to 1979, decreased in early 1980, and began a recovery in 1983. Because of the pressing need of the developing countries for foreign currency, production generally grew faster than consumption, which led to increasing stocks. After the mid-1970s recession, prices rose steadily, but they began to fall again in the early 1980s. In 1982 real prices for many of the major non-ferrous metals were the lowest they had been in the previous three decades. In 1983 prices recovered.

Aluminium

Aluminium production increased every year from 1970 to 1980, except for 1975, when it dropped as a result of the world recession; in 1980 it increased by 5.4 [illegible]duction only fell in 1981 by 2.1 per cent and declined [illegible]er cent in 1982. However, in the early 1980s the aluminium [illegible]rienced a significant decrease in consumption: 4.4 per cent in [illegible], 5.1 per cent in 1981 and 2.4 per cent in 1982. In 1983 there was an upturn. The imbalance between consumption and production in 1980 and 1981 increased stocks, which had a major impact on the level of prices. The prices in the London Metal Exchange fell from £766.53 per metric tonne in 1980 to £567.0 in 1982. In 1983, however, prices increased again.

Copper

Refined copper consumption decreased in the mid-1970s, but then recovered, attaining a peak in 1979. Consumption then declined by 4.5 per cent in 1980, increased slightly in 1981, decreasing again by 4.6 per cent in 1982 and by 2 per cent in the first nine months of 1983. Production of copper in 1980 and 1981 continued to increase, declining slightly by 1.7 per cent in 1982 and increasing again by 2.5 per cent in the first nine months of 1983. The widening supply-demand imbalance increased stocks, so that in 1982 they equalled two months' consumption. Copper prices fell in 1981 and 1982, began to increase in 1983, but by October were again down to the previous years' depressed conditions.

Tin

Refined tin consumption has shown a long-term downward trend since 1974. This tendency has been more pronounced since 1979. Consumption of refined tin declined 4.4 per cent in 1980, 5.1 per cent in 1981 and 2.4 per cent in 1982.

In 1983, world consumption of primary tin was less in the second quarter than in the same period of the previous year. The world supply of tin decreased by less than the demand, resulting in an increase in commercial stocks of refined tin, from 4 per cent of annual consumption in 1978 to 18.7 per cent in 1982. Tin prices were sustained by the constant support buying from the buffer stocks of the International Tin Agreement (ITA), and also by its export restrictions.

Nickel

Consumption of refined nickel recovered after a drop in the mid-1970s, but decreased again after 1979. In 1980 consumption of refined nickel decreased by 8.4 per cent, in 1981 by 8.6 per cent and in 1982 by 4.2 per cent. In 1983 total nickel consumption increased in the market economies. Production of smelter-refined nickel attained its peak in 1980, declining afterwards by 5.2 per cent in 1981 and by 11.9 per cent in 1982. Nickel stocks reached their peak in 1977, when they were equivalent to approximately 4.7 months of consumption. Afterwards, there was a decline in the stocks because of cutbacks in production. Prices began to decrease from 1978 onwards. Producer prices in the United States in 1980 and 1981 increased in comparison to 1979, but decreased again in 1982 and 1983. The London Metal Exchange price of nickel increased in 1983.

Zinc

Consumption of slab zinc decreased in the mid-1970s, experienced a recovery up to 1979, but then decreased by 2.8 per cent in 1980, by 2.1 per cent in 1981 and by 1.3 per cent in 1982. In 1983 consumption increased again, due mainly to increases in consumption in the United States and Japan. Production decreased by 4.4 per cent in 1980, increased slightly in 1981, and decreased in 1982 by 3.7 per cent. The cutbacks in production have contributed to a significant reduction in the stocks, which in 1983 were approximately 45 per cent less than in 1975. Prices were relatively low up to 1980 because of the high level of stocks. In 1981 a significant increase in prices began that has continued up to the present.

Lead

Consumption of refined lead increased from 1970 to 1974, but decreased by 10 per cent in 1975. After the world recession of the mid-1970s it increased

again, attaining its peak in 1978. Since 1979 the consumption of lead has decreased. In 1980 consumption fell by 2.8 per cent, in 1981 by 1.7 per cent and in 1982 by 0.2 per cent. In 1983 the upturn in the world economy did not generate an increase in consumption, and the situation has remained virtually static. Production declined less than consumption. Production of refined lead decreased by 5.2 per cent in 1975, recovering afterwards and reaching its peak in 1979. In 1980 production decreased by 1.7 per cent, in 1981 by 1.3 per cent and in 1982 by 1.6 per cent. The early 1980s have been characterized by a persistent excess of supply over demand. This oversupply has made prices fall from the peak attained in 1979.

Structure

The structure of the non-ferrous metals industries depends to a great extent on the growth and logic of development of the capital goods industry. The characteristics of metals such as aluminium and nickel cause them to be most closely linked with the present pace-setter capital goods industries. The developed market economies, which are the main producers of capital goods, are the major consumers of non-ferrous metals, mainly aluminium and nickel. These countries are also the major processors of mineral ores despite the fact that they are not the main mining producers.

Developed market economies

In 1980 the developed market economies consumed approximately 68.2 per cent of primary aluminium, 67.9 per cent of refined nickel, 65 per cent of refined copper, 64.5 per cent of refined tin, 60.6 per cent of refined lead, and 57.1 per cent of slab zinc.

The developed market economies contribute a significant share of global processed output, more than 50 per cent for all metals except tin. In 1980 these countries accounted for 68 per cent of world production of primary aluminium, 61.6 per cent of the production of refined lead, 60.7 per cent of slab zinc, 57 per cent of smelter-refined nickel, 50 per cent of refined copper and only 14.5 per cent of refined tin.

The developed market economies produce a significant share of the mining output of zinc, lead and nickel. In 1980 they produced 51.5 per cent of the

world mining output of zinc, 46.5 per cent of lead and 39.8 per cent of nickel. They also produced 36.9 per cent of bauxite, 30.3 per cent of copper, and 7.1 per cent of tin.

Developing countries

Developing countries account for a small share of world consumption and processing of non-ferrous metals, despite their major share in mining production. The development of their non-ferrous metals industries is externally oriented, as can be seen by the high percentage of non-ferrous metals production that is exported. In 1980, the developing countries accounted for 13.4 per cent of the consumption of slab zinc, 5.7 per cent of refined nickel, 11.3 per cent of refined lead, 8.9 per cent of refined copper and 9.2 per cent of primary aluminium.

The participation of developing countries in non-ferrous metals processing is insignificant compared to their contribution to mining output. Tin is the only metal in which the developing countries have a high participation in processing output. In 1980 the developing countries accounted for 70.7 per cent of the world production of refined tin. For copper, their share was 23.2 per cent, for smelter-refined nickel production it was 15.3 per cent, for refined lead 13.5 per cent, for slab zinc 12.2 per cent, and for primary aluminium 10.7 per cent.

Developing countries are the major producers of mining output of tin, bauxite and copper. In 1980 they produced 76.8 per cent of the world mining output of tin, 50.5 per cent of bauxite and 43.9 per cent of copper. In nickel they produced 34.6 per cent, in lead 24.3 per cent and in zinc 22.7 per cent. The share of total production that is exported varies from 89.2 per cent of tin to 35.6 per cent of lead.

Centrally planned economies

Consumption by the centrally planned economies in 1980 accounted for 24.3 per cent of slab zinc, 23.8 per cent of refined nickel, 22.9 per cent of refined lead, 20.1 per cent of refined copper, 18.1 per cent of refined tin and 17.7 per cent of primary aluminium. The participation of these countries in world processing output of each of the non-ferrous metals is approximately 20 per cent, with the exception of tin which is only 7.8 per cent.

Centrally planned economies have a low participation in world trade of non-ferrous metals, compared with the other groups of countries, because their production is mainly oriented towards satisfying their domestic demand. Their contribution to exports varies from 10.7 per cent in the case of nickel to 1.9 per cent for tin. With respect to imports, their share does not exceed 15 per cent of the world's imports of any of the different metals.

Degree of concentration and structure of ownership

The non-ferrous metals industries are highly concentrated industries. In the cases of both aluminium and nickel, where the concentration is highest, production is concentrated mainly in the hands of the TNCs. In the other metals the level of concentration is lower and there is a greater participation of developing country state enterprises (copper, tin) and of small and medium-sized enterprises (zinc, lead).

In aluminium, the twelve largest enterprises accounted for 76.3 per cent of the total bauxite production of the market economies in 1977. Among these enterprises, six major TNCs accounted for approximately 57.8 per cent of production and three state enterprises produed 9.3 per cent of the total. The six major transnational corporations accounted for 41.3 per cent of total market economy production of aluminium.

In nickel, eight companies account for 79 per cent of the world market economy's mining capacity and 76.9 per cent of their processing capacity. The six major TNCs participate with 69.7 per cent of the mining and 68.8 per cent of the processing capacity, and the two major state enterprises in developing countries with 9.3 per cent of mining capacity and 8.1 per cent of processing.

In copper, 53.4 per cent of the total market economy mining production is accounted for by twelve enterprises, Codelco being the major company. This is a state enterprise that has approximately 11.5 per cent of the world market economy mining capacity. The eight most important TNCs contribute with 27.3 per cent of the world market economy capacity and the four most important state enterprises of the developing countries with 26.1 per cent. In processing output capacity, the 15 largest enterprises hold 73 per cent of total smelter capacity in the market economies and 63 per cent of refinery capacity. Of these, twelve TNCs have 48.9 per cent of smelter capacity and

46.7 per cent of refinery capacity, while three developing country state enterprises have 24.1 per cent of the smelter capacity and 16.3 per cent of the refinery capacity.

In tin, the three largest mining enterprises are state companies. The largest company is P.T. Timah (Indonesia), which produces 10 per cent of world output, second is Comibol (Bolivia), with 9 per cent, and finally the Malaysia Mining Corporation Bhd. (MMC), with 8.5 per cent. In processing, eight companies have approximately 88.9 per cent of the world market economy tin smelting capacity. Two major state enterprises of developing countries participate with 17.1 per cent (P.T. Timah, Comibol); the major private company from a developing country is from Malaysia, with 17.1 per cent; and five TNCs have 54.7 per cent.

In zinc, eleven major companies concentrate 45.2 per cent of world mining capacity in the market economies. Centromin, a Peruvian State enterprise that is one of the eleven major companies, contributes with 4.9 per cent of the world capacity. In zinc reduction, eleven major enterprises account for approximately 53.7 per cent of the world market capacity.

In lead, no single firm or group accounts for more than approximately 8 per cent of the total of the world market economy's primary lead refining, even though the major thirteen account for 67.4 per cent of this capacity. The two major developing country state enterprises account for approximately 10 per cent of the capacity of the world market economies.

Restructuring

The main changes in the structure of the non-ferrous metals industries are the following:

(a) The developing countries generally increased their share in world mining output. The main increases were in copper and nickel, with increases of 4.9 per cent and 3.9 per cent respectively in the period between 1972 and 1980. In the case of tin there was a slight increase of 1.3 per cent in the share of the developing countries, in zinc and lead their contribution was practically without change, and in bauxite there was a decrease of 0.8 per cent.

The developed market economies decreased their share of mining output in all the minerals under study, with the exception of bauxite, where they had an increase of 4.4 per cent. There were considerable reductions in their share of the mining production of nickel and copper - of 8.5 and 8.1 per cent respectively. Their decrease in mining production of zinc was 3.7 per cent, of lead 3.1 per cent, and of tin 0.5 per cent.

The centrally planned economies increased their participation in mining output in almost all the minerals, with the exception of bauxite, where they experienced a decrease of 4.6 per cent.

(b) The developing countries increased their share in the consumption of processed metals. They increased their participation in consumption in the period 1972-1980, by 4.6 per cent in zinc, by 3.4 per cent in nickel and copper, by 2.8 per cent in aluminium, by 2.7 per cent in tin, and in lead by 2.2 per cent.

The developed market economies decreased their share in world consumption of all the metals under consideration between 1972 and 1980. The decrease in aluminium was 5.2 per cent, in zinc 10.5 per cent, in tin 7 per cent, in lead 3.5 per cent, in nickel 3.8 per cent and in copper 7.5 per cent.

In the period under study, the centrally planned economies increased their share of world consumption of all metals with the exception of aluminium where their share remained the same. In zinc they increased their participation by 5.1 per cent, in tin by 4 per cent, in lead by 1.1 per cent, in nickel by 1.7 per cent, and in copper by 2.1 per cent.

(c) In the 1970s the developing countries increased their participation in the production of the processed metals under study, with the exception of lead where they had a slight decrease. These countries increased their share in aluminium by 4.5 per cent, in copper by 3.7 per cent, in tin by 8.7 per cent, in nickel by 2.7 per cent, in zinc by 2.6 per cent, and in lead they experienced a slight decrease of 0.1 per cent.

The developed market economies decreased their share in the world processing output in the period under study in all the metals, with the exception of lead where they experienced a slight increase of 1 per cent.

The centrally planned economies had an increase in the share of the processing output in all the metals under study with the exception of aluminium and lead.

(d) The concentration of the non-ferrous metals industries has decreased, lessening the importance of the oligopolistic barrier to entry into these industries.

This decrease in the degree of concentration was due mainly to the reduction of the dominant role played in the 1950s by the enterprises of the United States and England, due to the increasing importance played by enterprises from Japan and Europe and by national enterprises of developing countries.

(e) The non-ferrous metals industries have experienced changes in their patterns of investment. Since approximately the end of the 1960s the major TNCs have decreased their direct investment in the developing countries.

The new patterns of investment that are taking place have created an apparent paradox in mining and processing of non-ferrous metals, a paradox that lies in the decreasing direct investment in equity by the TNCs in the developing countries, and the increased participation of the developing countries in mining, consumption, and processing.

This apparent contrast can be explained by the increasing role of the governments in the developing countries, and initiatives taken by the TNCs for conversion from fully foreign-owned subsidiaries into joint ventures with national enterprises. This is also explained by the important substitution of loans for equity in the financing of non-ferrous metals projects in developing countries. There was a reduction of private equity from approximately 88-90 per cent of the total capital up to 1960, to about 33 per cent by the 1970s.

This spread of new patterns of investment arrangements has accelerated since the mid-1970s with the appearance of new sources of finance such as the transnational oil companies, governments of the oil-producing countries, insurance companies from western countries, and merchant finance and equipment-leasing schemes.

I. EVOLUTION OF THE NON-FERROUS METALS INDUSTRIES

A. General aspects

The metallurgical industry is an intermediate industry, in that its dynamic and structure is defined by the development of its final users - basically capital goods, consumer durables and the construction sector.

In England, the metallurgical industry assumed a significant role beginning in the 1870s in the process of industrialization, due to the increasing amount of steel needed for the production of capital goods, which were required by the industrial apparatus to increase productivity.

The development of new capital goods industries at the beginning of the twentieth century increased the importance of the non-ferrous metals industries. The copper industry developed because of the increasing growth of the electrical industry[1/]; nickel was used to harden steel in order to increase the durability of machinery and equipment, and also for the production of weapons; the growth of the aluminium industry was associated with the development of the transport sector, mainly the aircraft industry.

During that period, the non-ferrous metals industries of the United States had a dominant position in the production of nickel, copper and aluminium. In nickel, the United States controlled the world's largest supply source in Canada, which was exploited and processed by INCO[2/]. In copper, the United States first applied the techniques of mass production to copper mining in 1905 at the Bingham Canyon open-pit mine in Utah. This large-scale mining technique was also applied in Ely, Nevada in 1908; and later in 1910 at Miami, Arizona and afterwards in the Arizona mines and in New Mexico[3/]. The predominant position of the United States in copper was also due to its control

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1/ The growth of electrical energy for power, lighting and communication led to a doubling of the world demand for copper every few years. In 1860 the output of the world's copper mines was only about 100,000 tonnes. By 1912 it had reached one million tonnes. Mikesell, Raymond, "The World Copper Industry, London, 1979.

2/ INCO is nominally a Canadian company but is controlled by United States capital. In 1913 INCO controlled 55 per cent of the world's nickel production. For further details see Tanzer, Michael, "The Race for Resources", New York, 1980.

3/ Mikesell, "The World Copper Industry", op. cit., pp. 6-7.

of Chilean copper mines. In 1904 the Braden Copper Corporation was formed to exploit the mine El Teniente, which was later acquired by the Kennecott Copper Corporation. Shortly thereafter Chiquicamata, another Chilean mine, was developed and later sold to Anaconda[4/]. In 1902 the Cerro de Pasco Mining Company also developed a copper mine in Peru, but its output was small compared to that of the Chilean mines.

The major role of the United States in world production of aluminium was mainly due to its control of the technology. In the mid-1880s there was an important technological discovery of how to produce aluminium based on a low cost electrolytic process for separating aluminium from its oxide. The United States patents were granted to Pittsburg Reduction Company, which afterwards became the Aluminium Company of America (ALCOA). On the basis of this new technology, the Pittsburg Reduction Company substantially reduced aluminium prices[5/].

The increased internationalization of the non-ferrous metals industries began in 1889 with efforts in ore exploration, with Africa becoming an important supplier only after the First World War. The British South Africa Company (BSAC) was in charge of the exploration of copper mines in Northern Rhodesia (now Zambia) and Belgium had interests in the Belgian Congo (now Zaire). BSAC granted mineral exploration rights in Northern Rhodesia to other companies in exchange for royalties.

All the mines of Northern Rhodesia came under the control of two groups: the Anglo-American Corporation of South Africa, with majority British ownership and minority United States ownership, and Rhodesian Selection Trust, with majority United States ownership. The copper mines in the Katanga region of the Congo came under the control of Union Minière du Haut-Katanga, which was mainly owned by Belgium but had a minority British ownership[6/]. The First World War created an important increase in demand for aluminium, which caused United States, German and Italian firms to search for new bauxite reserves, mainly in Europe and in Canada[7/].

4/ Le Monde, "L'Eclat du Cuivre", 10 April 1984.

5/ By then Europe had also developed the required technology (France, Great Britain, Switzerland).

6/ Mikesell, "The World Copper Industry", op. cit., p.8.

7/ Tanzer, "The Race for Resources", op. cit., p. 73.

The Second World War created a vast increase in the demand for minerals, which made non-ferrous metal companies from developed countries (mainly the United States) increase their number of operations in the developing countries. Other major causes of this new trend were the decline of low cost reserves in the United States, the existence of important mineral deposits of high grade ore in the developing countries[8/], and the improvements in transportation of these ores.

Peru, the Philippines and Papua New Guinea[9/] appeared as new large developing country producers of copper, being added to Chile, Zambia and Zaire. United States foreign investment was mainly responsible for the increase in production in the Philippines and Peru, while the expansion in Papua New Guinea was due to investments of British and Australian capital[10/]. In the aluminium industry, the United States companies made direct foreign investments in Australia, the Caribbean countries and Africa, controlling 60 per cent of world aluminium production by the beginning of the 1970s. In tin, the expansion of production was based on production increases in Malaysia, Indonesia and Bolivia, where a national entrepreneur, Simon Patiño, built up the major TNC in the tin industry, which by the 1950s had expanded its operations to outside Bolivia[11/]. In the nickel industry, the TNC, INCO, expanded its activities throughout the world, producing about two-thirds of the nickel for the non-socialist world by the early 1960s. However, the subsequent development of new nickel mines, particularly in the developing countries, undermined its monopoly position.

In the 1960s the developing countries adopted new policies intended to increase their control over the valorization of their raw materials. There was a process of nationalization, mainly in copper, an increase in the taxes charged to the TNCs, and the formation of producers' associations in order to attempt to control the evolution of prices.

8/ The difference in ore grade between the developed and developing countries was significant, and remained so up to the 1970s. The main exceptions were Australia and Poland.

9/ New large producers also appeared, such as Yugoslavia, Poland, South Africa and China.

10/ United States and British capital developed the South African copper industry.

11/ UNCTC, "Transnational Corporations in the Mineral Industries of Developing Countries. Analysis and Policy Issues", New York, 1983.

These new trends in the developing countries caused the dominant TNCs to adopt new strategies. They directed their new investments mainly towards stable developed countries and to those developing countries where the risk of nationalization was perceived to be minimal. They also increased their degree of vertical integration and developed new methods of exploiting reserves (open-pit mining). In the 1960s the dominance of the United States began to decrease because of all these trends, and because of the major role that Japan and Western Europe began to play in the production of non-ferrous metals.

In the 1970s approximately 85 per cent of the world's mineral exploration was undertaken in developed countries[12/]. In some cases these mineral explorations were in deposits that had lower percentages of mineral content than those of some developing countries. To exploit these relatively poor mineral deposits, it was necessary to develop, as already mentioned, capital-intensive mining methods which small and medium-sized companies could not afford. There was also a decrease in direct investment in mining and processing in developing countries that was replaced by lending.

B. Evolution of the main non-ferrous metals

This section discusses the specific historical evolution of the main non-ferrous metals, against the background of the general process of development of this industry outlined in the previous section.

1. Aluminium

The aluminium industry began to develop in the mid-1880s, mainly because of the discovery of a low-cost electrolytic process for separating aluminium from its oxide. Because at first the demand for aluminium was low, Alcoa, the major aluminium enterprise, began creating markets between 1890 and the 1920s. In the 1890s, Alcoa started fabricating cooking utensils, rolled sheet and plate and electrical conductor wires and power lines. In the early years of the twentieth century, Alcoa introduced aluminium products for use in the transport sector (airplane engines, auto pistons, truck bodies).

12/ Most of these explorations were in Australia, Canada, South Africa and the United States.

After the First World War the consumption of aluminium increased rapidly. In the Second World War the production of aluminium grew to 1,992,000 tonnes, a level that was attained again only at the beginning of the 1950s. In the period between 1950 and 1973 the world consumption of aluminium increased at an annual rate of 10 per cent, but it began to decrease after 1973 because of the reduction in demand of the main consumer countries, primarily the United States[13/].

There are five phases in the evolution of aluminium production in the period between the Second World War and the crisis of 1974-75. Between 1947 and 1957, production capacity was lower than demand, and prices showed a sustained increase. The second period, between 1957 and 1963, was characterized by a situation of over-capacity, and the enterprises that controlled this industry began to stockpile their output. In this period, investments and prices decreased. The period between 1963 and 1969 was a period of under-capacity in which there was an increase in the level of prices. In 1970 a problem of over-capacity began to appear, which was accentuated in the years up to 1973. In 1973 this industry began a period of high capacity utilization, which was interrupted by the world economic crisis[14/].

The aluminium industry has always been concentrated among a few enterprises. Alcoa was the enterprise that played the major role in promoting consumption and increasing production at the beginning of the century. In the first 20 years of the twentieth century, Alcoa began acquiring bauxite mines in Arkansas, U.S.A., Dutch Guiana and Surinam. The leading European company during this period was Alusuisse, which produced aluminium using French bauxite and Swiss hydro-electric power. Other major enterprises were Forges and Pechiney of France and the British Aluminium Company.

In 1928 Alcoa created Aluminium Ltd., which today is Alcan[15/]. During the Second World War, because of the policy of the United States Government related to strategic inputs, Alcoa gave birth to two future competitors,

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13/ UNITAR, "Perspectives de L'Industrie de L'Aluminium en Afrique", p.8.
14/ Ibid, p. 49.
15/ The United States Government considered that Aluminium Limited was created basically to permit Alcoa to participate freely in European cartels and fix aluminium prices without taking into account United States prohibitions. For further details see Tanzer, "The Race for Resources", op. cit., p. 138.

Kaiser Aluminium and Reynolds Aluminium. Alcoa provided them with the patented technology for free and initially provided them with bauxite. Afterwards they acquired their own mines in the Caribbean area.

After the Second World War the production of aluminium was concentrated mainly in the North American companies. In 1948 the four largest North American enterprises together produced 990,000 tonnes, while the major European firms of France, England and Switzerland produced a total of only 220,000 tonnes. This dominant position of the North American firms was based mainly on the control that they had of low-cost bauxite reserves in the world and also because of the high demand for aluminium within the United States[16/].

In 1979 the six major transnationals: Alcan, Alcoa, Kaiser, Reynolds, PUK and Alusuisse produced 41.3 per cent of the world output of aluminium[17/]. Among these, the dominant position is held by the major United States enterprises. One of the main reasons is their major share of the most important new sources of bauxite in Australia and Guinea. The largest mine in Australia, Weipa, is controlled mainly by Kaiser Aluminium and Rio Tinto Zinc[18/]. In Guinea, Halco, the world's largest bauxite mine, is owned mainly by Alcoa and Alcan[19/]. Another reason for this concentration is that the aluminium industry has a high degree of vertical integration, far more than the copper industry, for example, so it is very difficult for independent enterprises to buy bauxite for further processing. The high degree of vertical and also horizontal integration of the big firms has meant that most product exchanges stay within the firms. There are a few exceptions in countries like Guinea and Guyana that can sell their production of bauxite and alumina through long-term agreements with the consumer countries[20/].

The strong control of the market by big firms has given them an important role in the determination of prices. Alcan, Alcoa and Kaiser are the leaders that set the prices. This situation is different to the copper industry where

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16/ Tanzer, "The Race for Resources", op. cit., pp. 139-140.

17/ UNCTC, "Transnational Corporations in the Bauxite/Aluminium Industry", New York, 1981, Table 15.

18/ Australia owns 10 per cent.

19/ In Halco, Alcoa has 27 per cent ownership, 27 per cent by Alcan, 20 per cent by Martin Marietta Aluminium (a small United States producer), 10 per cent by Pechiney, and the rest by Italian and German firms.

20/ For example, the long-term agreement between Guinea and the USSR for bauxite.

the London Metal Exchange sets the prices[21]. This control of the companies over supplies and prices has greatly helped them to increase aluminium prices, from $0.14 per pound in 1948 to around $0.25 per pound by the mid-1960s, $0.34 per pound in 1974 and $0.66 per pound in 1979[22]. This ability of the big firms to control supplies and prices up to the end of the 1970s produced stable profits, a situation that differed from that of the copper industry, where profits fluctuated, depending on world economic cycles.

2. Copper

The world consumption of copper amounted to only 50,000 tonnes per year in the mid-nineteenth century. It had increased to about 450,000 tonnes per year by 1900 and in 1973-1974 it was approximately 8.5 million tonnes[23]. This significant growth in the consumption of copper was mainly a result of the advent of the "electrical age"[24].

During the period 1961-1974, however, the intensity of use of copper in industrial production declined significantly. The ratio of the index of copper consumption to the index of industrial production declined by 15 per cent in the United States and by a larger percentage in Europe (United Kingdom, Federal Republic of Germany, France and Italy)[25]. This was due mainly to changes in the composition of industrial output, which generated a process of substitution of other materials of lower weight for copper, as well as other technological changes that reduced the use of copper. In the United States in 1973, 31 per cent of copper consumed was used in electrical equipment, in contrast with 40 per cent in 1938. The consumption of copper in the construction sector and the consumer goods industries was 19 and 16 per cent in 1938 and only 11 and 6 per cent respectively in 1973[26].

21/ UNITAR "Perspectives de L'Industrie de L'Aluminium en Afrique", op. cit., pp. 45-46.
22/ Tanzer, "The Race for Resources", op. cit., p. 142.
23/ Prain, "Copper: The Anatomy of an Industry", pp. 42-43.
24/ The structure and volume of copper consumption has been affected by the composition and evolution of the industrial output and its technological changes, mainly in the capital goods sector.
25/ Mikesell, "The World Copper Industry", op. cit., p. 13.
26/ Ibid., p. 14.

The situation of the copper industry is determined both by the general economic situation and the intensity of its use by its main consumers. Between 1950 and 1954 there were significant increases in the demand for and prices of copper caused by the general prosperity resulting during the post-war reconstruction, and also supported by stockpile buying by the United States during the Korean War[27/].

In the years 1957-58 the demand for copper decreased sharply, which made the copper industry enter a recession and reduced the real prices of copper to their lowest level in the post-war period. The price was $453 per tonne at constant 1950 prices. In the period from 1959 to 1963 activity in the copper industry increased in comparison to the preceding period, which raised prices, though to a level lower than the 1950-1954 average. The boom of the world economy during 1964 significantly increased the demand for copper and other metals and sharply raised copper prices, which reached their highest real price of $1158 per tonne in 1966[28/]. The beginning of the world recession in the mid-1970s made prices drop again[29/].

In 1913, the United States, through its big firms, produced 60 per cent of the world copper supply from domestic mines and another 20 per cent from subsidiaries Kennecott and Anaconda. Since then the level of concentration of the world copper industry has been progressively decreasing. In 1920, important discoveries of new resources, mainly in Africa, where there was an important participation of Belgian, British and South African capital, reduced

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27/ The increase in prices was also due to the strikes in Northern Rhodesia, the United States and Chile which in one year, 1955, represented approximately 5 per cent of world production. For details see UNITAR "The Copper Industry in Africa", p. 36.

28/ The rise of prices was stimulated by the Vietman War and the unilateral increase in the price of copper by Chile and also by the confrontation in 1966 between Zambia and Rhodesia, which had an important impact on the transportation of copper. Ibid., p. 37.

29/ It should be noted that the price of copper on the world market cannot be derived from usual notions of the relationship of supply and demand. Variations in copper prices do not necessarily correspond with movements in production. For example, at the end of 1974 there was a sharp fall in prices, but when the CIPEC countries cut back production at the beginning of 1975, there was no corresponding movement in prices. Prices did not begin to recover until April, 1975, when the supply was 600,000 tonnes, whereas it had been only 500,000 tonnes. For details see Mezger, Dorothea, "Copper in the World Economy", New York, 1980.

the share produced by the United States firms to approximately 50 per cent of total world production. This percentage decreased to 17 per cent during the Great Depression, but increased to approximately 33 per cent at the beginning of the Second World War[30/].

After the Second World War, the three largest copper-producing firms of the United States (Kennecott, Anaconda and Phelps Dodge) accounted for more than 80 per cent of United States production, while the seven largest firms in the world (the three cited United States enterprises, plus Union Minière in the Congo, the Anglo American Group, the Roan-Amex Group and Inco) accounted for 70 per cent of Western world production.

By 1978, however, the three biggest firms of the United States accounted for only 52 per cent of United States production and 10 per cent of world production, including that of the centrally planned economies[31/]. The seven largest firms were responsible for only 20 per cent of Western world production. The Government-owned mining enterprises in Chile, India, Peru, Turkey, Uganda, Yugoslavia, Zaire and Zambia, accounted for about 34 per cent of world mining output for the countries outside the Socialist countries in 1974[32/].

One of the major factors that contributed to reducing the degree of concentration in this industry during this period was the process of nationalization that took place in the main producer countries. Other factors included the discoveries of important new copper mines after the Second World War, the increase in the number of independent producers, and the entry of other natural resource-based firms (particularly the oil companies) into the copper industry[33/].

30/ "The Race for Resources", op. cit., pp 124-133.
31/ They produced 13 per cent of Western world production.
32/ Mikesell, "The World Copper Industry", op. cit., p. 29.
33/ After the Second World War new ore deposits were discovered in Peru, Zambia, the South Pacific (Indonesia, Papua New Guinea, Australia), Siberia, Iran and parts of Africa. In recent years, Exxon and Atlantic Richfield have made large investments in the copper industry in Chile. Texas Gulf has become a major producer in Canada. INCO, one of the main firms which produces nickel, has become an important producer of copper, because the production of copper is often associated with nickel production.

Since the 1960s, the major firms that produce copper have been developing strategies to maintain their control of this industry. They have undertaken new forms of mining that permit them to exploit mines with low levels of ore content. The open-pit method permits an economic recovery of low-grade mineral deposits; this method of extraction does, however, require high capital costs[34/]. The firms have also developed mining of the seabed, andit is predicted that by the year 2000, 3 per cent of the world supply of copper will come from that source.

At the level of industrial processing, the major firms have developed a continuous casting technology that transforms refined copper directly into the final product, rather than having to go through the traditional intermediate stage of manufacturing wire-bars. This new technology will tend to generate a greater concentration of the final manufacturing part of the process, because it is more efficient and more economic, due to transport costs and quality control problems when located near the markets, which are mainly in the developed countries[35/]. Technology has also been improved to increase the recycling content of the final product, reducing in this way the demand for raw material copper. Recycling now provides approximately 40 per cent of Western needs.

The major TNCs, in order to develop new technologies and protect their interests in the face of increasing participation by developing country governments, have developed engineering companies that will permit them to participate in the development of new projects in the developing countries without having to own a large share of the new company. The engineering companies, in addition to their function of developing new technological processes, assist in the installation of turn-key plants, or parts of plants, complex sets of equipment, technical assistance, etc.[36/].

34/ At the end of the 1960s, 60 per cent of the total copper production of the Western countries came from open-pit mining.

35/ The lengthy transport of sensitive wire is considerably more expensive than the transport of bars, creating a situation in which the producer countries become to some extent dependent on the refining and manufacture of their copper in the industrial countries. Mezger, "Copper in the World Economy", op. cit., p. 67.

36/ An example is the Lurgi company, an engineering company that is a subsidiary of Metallgesellschaft and is Metallgesellschafts' most profitable branch.

The real price of copper has fallen approximately 40 per cent in the twentieth century. The major copper firms have not been able to restrict supplies and thus increase prices and profits. This is due to the lower degree of concentration in this industry than in, for example, the aluminium industry, the wide utilization of copper throughout industry and other economic sectors and the fact that many other products can be substituted for it. Generally, the movement of copper prices provides a good indicator of the state of the world economy[37/]. Practically all internationally traded copper is sold at prices based on the London Metal Exchange.

In the 1970s the instability of prices and profits in the world copper industry was due to the fact that most of the state companies in developing countries that are major producers of copper continued to increase production, despite falling prices, because of their need to maximize foreign exchange receipts in order to alleviate their financial crisis[38/].

In the United States, the copper industry is to a high degree vertically integrated with the mine owners. This has permitted the United States to maintain a domestic price system in which the main producers fix the prices. However, in 1978 the major producer, Kennecott, abandoned its producer price and based its prices on the New York Copper Exchange (COMEX) transactions. It was followed by other major producers such as Anaconda. This has increased the instability of copper prices in the United States[39/].

37/ Robbins, Peter and Edwards, John, "Guide to Non-ferrous Metals and Their Markets", Rogan Page Limited, Great Britain, 1979, p. 104.

38/ As an example we can see that in the period between 1973-78, while the western world production decreased slightly, the Chilean production increased by 44 per cent.

39/ Robbins, and Edwards, "Guide to Non-ferrous Metals and Their Markets", Rogan Page Limited, Great Britain, 1979, op. cit., p. 105.

3. Tin

Annual tin production expanded less than did that of other non-ferrous metals between the annual average production for the period 1875-1899 and the period 1950-1976. Between these periods the average annual tin production increased 2.92 times[40/]. At the beginning of this century the yearly production of tin increased from 79,300 tonnes in 1900 to 134,000 tonnes in 1917. Prices also increased between 1900 and 1913[41/]. Tin production decreased after the First World War, increased again in the second half of the 1920s, and decreased again during the world recession of the 1930s. Production increased substantially with the beginning of the Second World War, reaching its peak in 1940 and 1941. Prices fluctuated greatly during the period between the two wars. In the United Kingdom for example, the price of tin was higher in 1934 than in 1913, but in 1938 it was lower than in 1913[42/].

Tin production and consumption, which had reached very low levels at the end of the Second World War[43/] entered a period of growth in the post-war years[44/]. One aspect that influenced the expansion of demand was the acquisition of tin by the United States for its strategic stockpile[45/].

40/ By comparison: aluminium increased 77.5 times, nickel 162.5 times, copper 19.2 times, zinc 12.8 times and lead 5.1 times. Schmitz, Christoper, "World Non-ferrous Metal Production and Prices, 1700-1976", London 1979, p. 7.

41/ The deflated prices in £/tonne increased from £149.78 in 1900 to £205.13 in 1913.

42/ The prices of tin in the United Kingdom were £201.1 per tonne in 1913, £226.7 in 1934 and £186.6 in 1938. In 1940 and 1941 the prices increased significantly: in 1940 the price was £252.56 per tonne and in 1941 £257.17 per tonne.

43/ In 1945 production of tin was only 97,000 tonnes.

44/ The United States, in view of the tin shortage, imposed restrictions on the use of tin from 1942 until 1949. "Tin Production and Investment", International Tin Council, London 1979, p. 101.

45/ During the Second World War, the United States had stockpiles of 61,000 tonnes. In 1961 the size of the stockpile was 355,000 tonnes and of this, 167,000 tonnes were declared surplus. Ibid., p. 101.

After a period of stockpiling in 1954-1955, there was a period of over-supply lasting from 1956 to 1961. The over-supply was increased after 1957 by large quantities exported by China and the USSR. This period of excess supply coincided with the period between the conclusion of the First International Tin Agreement in 1956 and the end of the Agreement in 1961. During this period of over-supply in the tin industry, prices decreased between 1956 and 1958, but showed a small increase in 1959 and a significant one in 1961. Table 1 shows the changes in world production and prices in the period 1956 to 1961.

Table 1 Tin Supply and Prices (1956-1961)
(In thousand tonnes)

	1956	1957	1958	1959	1960	1961
World production of tin - in concentrates a/ (thousands of tonnes)	169.1	165.7	117.6	121.1	138.7	138.7
Penang tin price (M $/pickel)	387.0	373.0	369.0	397.0	394.0	447.0
LME standard tin (£/long tonne)	774.0	741.0	735.0	786.0	794.0	895.0

a/ Does not include the production of the centrally planned economies.
Source: International Tin Council

The period between 1961 and April 1963 was one of great uncertainty, because of the process of approval of the United States tin disposal plans[46/], and production and prices showed slight changes in this period. Between 1964 and 1968 production increased with the result that prices fell in both current and real terms from 1966 to 1968. There was a cyclical swing in real prices from 1968 to 1971; however, world production continued to rise until 1972. Table 2 shows the changes in world production and prices in the period 1962-1972. World tin production fell continuously from 1972 until 1976, while prices fluctuated greatly, reaching their lowest level in 1975.

46/ In 1961 and 1962 the United States tin disposal plans came under discussion. In June 1961, the United States Government approved disposals of 51,000 tonnes of tin metal. Disposals began in September 1962 and a new one-year disposal programme began in April 1963.

TABLE 2. Tin supply and prices, 1962-1972

Year	World production of Tin - in concentrates[a/] (thousands of tonnes)	Penang tin prices (M$/pickel)	London Metal Exchange Standard tin prices (£/long tonne)
1962	143.5	448	884
1963	143.2	455	893
1964	148.7	619	1,198
1965	154.5	703	1,379
1966	166.2	645	1,266
1967	172.9	600	1,201
1968	183.1	566	1,307
1969	178.0	626	1,431
1970	185.7	665	1,527
1971	187.1	632	1,443
1972	195.9	627	1,515

Source: International Tin Council.

a/ Does not include the production of the centrally planned economies.

The world tin industry has a relatively high level of concentration: the eight largest smelters account for over 88 per cent of the total estimated capacity. While the largest tin companies of the world are the state companies, P.M. Timah in Indonesia and COMIBOL-ENAF in Bolivia, the marketing and production are mainly in private hands[47/].

In contrast to the aluminium industry, where TNCs are predominant at the mining and processing stages, control of the tin industry by TNCs in the mining and processing stages is much less pronounced, and governments of the major producing developing countries have been significant actors since the Second World War[48/]. Tin production was mainly concentrated in the south-west of England from medieval times until the third quarter of the nineteenth century; however, since the 1880s Malaysia has dominated world production of tin, followed closely by Indonesia and Bolivia, where deep mining of the metal was begun on a large scale after 1890[49/].

In South East Asia, TNCs and small-scale mining enterprises have operated side by side for many years. In Malyasia, TNC control became concentrated in the London Tin Corporation, which by the Second World War accounted for half of Malaysia's tin output. Since the Second World War the South East Asian countries have increased their control over tin production. In Malaysia the Government acquired control over the London Tin Corporation, and Indonesia nationalized the Billiton operations in the mid-1950s. Recently, however, several TNCs have begun new mining operations in Indonesia[50/].

47/ "Preliminary Study in the Non-ferrous Metals Industry", Negotiations Branch, UNIDO, March 1984.

48/ Kňakal, Jan, "Government Policies Toward TNC's in the Tin Industry of Bolivia and Southeast Asia", ECLA, 1983.

49/ Schmitz, "World Non-ferrous Metal Production and Prices 1700-1976" op. cit., p.16.

50/ In Thailand, Shell (Billiton) is the major tin mining operator. Also operating in Thailand are the St. Piran group of the United Kingdom and Amalgamated Metal Corporation, formerly part of the Patiño group now owned by Preussag.

By the 1950s a national TNC owned by the Patiño group in Bolivia had expanded to control mines in Nigeria and Malaysia and smelters in Australia, the United Kingdom, the Federal Republic of Germany, Malaysia and Nigeria. In 1952 the Patiño group and two other Bolivian-based TNCs produced 72 per cent of Bolivian tin output. These companies were nationalized in 1952, and are now under the control of the state company, COMIBOL, which operates the mines, and a state smelting company, ENAF[51/].

An analysis of the evolution of the production and prices of tin does not show any long or medium-term trends in prices. One aspect that tends to accentuate price fluctuations is the peculiar nature of tin supply, which is not governed by the requirements of consumer industries, but rather generally follows the level of industrial activity in developed countries[47/]. The long history of price fluctuations has demonstrated that producers have had difficulty in controlling prices. Prices for supply contracts are often based on a mixture of quotations from the Penang and London Metal Exchange, and there is a great deal of arbitrage between the two markets.

There have been attempts to control the volatility of tin prices in recent years through a major extension of the International Tin Agreement, between producers and consumers. The agreement defines "floor" and "ceiling" price levels and attempts to keep prices between these limits, occasionally using export controls. The Agreement has been largely ineffective since 1978, when the buffer stock supply was exhausted and market prices were above the "ceiling" level[53/].

51/ UNCTC, "Transnational Corporation in the Mineral Industries of Developing Countries: Analysis and Policy Issues", New York, 1983.
52/ "Tin Production and Investment" op. cit., p. 108.
53/ Robbins, and Edwards, "Guide to Non-ferrous Metals and Their Markets", London, 1979, op. cit., p. 160.

4. Nickel

Nickel is one of the non-ferrous metals for which annual production expanded greatly between the average annual production for the period 1875-1899 and the period 1950-1976. Between these periods, production increased 162.5 times, the largest increase after aluminium[54/]. Production increased significantly during the First World War because of the demand for military uses[55/]. After the war, production decreased until 1929-1930 when it increased briefly[56/], to decrease again because of the world economic crisis of the 1930s[57/]. Production of nickel expanded again during the Second World War[58/]. It suffered a decrease from the end of the war until the beginning of the 1950s, when it increased substantially; this was dampened only by the world economic crisis of the mid-1970s and 1980s. The main reasons for this steady expansion were the restructuring of European industry after the Second World War, the Korean war, the war in Vietnam, the world-wide boom in stainless steel[59/], and technological advances leading to growing nickel consumption[60/].

The degree of concentration in the nickel industry is high, comparable only to that of the aluminium industry. The main producer of nickel is Inco, whose headquarters are in Canada. Inco is nominally a Canadian company but is controlled by United States investors.

In the pre-World War I period, Inco greatly expanded production from its low-cost Sudbury mines, and averaged a profit rate on stockholders' investments of about 50 per cent. The only competitors that Inco had at that time

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54/ Schmitz, "World Non-ferrous Metal Production and Prices 1700-1976" op. cit., p. 7.

55/ The production increased from 9.5 thousand tonnes in 1900 to 48 thousand tonnes in 1917.

56/ The production in 1929 was 58 thousand tonnes and in 1930, 60 thousand tonnes.

57/ Production decreased until 1934 (72 thousand tonnes), when it began to expand again.

58/ The production of nickel was of 138 thousand tonnes in 1938 and 154 thousand tonnes in 1944.

59/ The manufacture of stainless steel requires nickel.

60/ United Nations, "The Nickel Industry and the Developing Countries", New York, 1980, p. 19.

were Le Nickel[61/] and Mond Nickel who sold their production mainly to the British market. In 1913 Inco controlled 55 per cent of world nickel production, Le Nickel 33 per cent and Mond Nickel 11 per cent.

In 1928 Inco merged with Mond Nickel, thus gaining control over 90 per cent of the world market. Also in that year, its Canadian subsidiary became the parent company[62/]. In 1950 Inco, SLN and Falconbridge together controlled 95 per cent of world production capacity[63/]. In the early 1960s Inco still produced approximately 65 per cent of the non-Socialist world's supply, and Falconbridge produced 10 per cent, while the rest was produced mainly by Le Nickel, Sheritt Gordon and Hannan Mining. In the 1960s and 1970s there was a decrease in concentration because of the entry of new producers, including Western Mining in Australia, the Japanese processing plants, Amax in Botswana and the United States, Marinduque in the Philippines, and others[64/]. As a consequence of this, the share of Inco in world production in 1978 was down to 31 per cent. Inco, SLN and Falconbridge together currently account for about 55 per cent of the mining and processing capacity in the market economies[65/].

The high concentration of the nickel industry has allowed producers a large amount of control over prices, with Inco having the dominant influence in producer pricing. This has resulted in prices remaining relatively stable, with periodic changes to cover rising production costs[66/]. Nickel prices were stable from 1926 to 1941, despite fluctuations in demand[67/]. They experienced a significant increase at the beginning of the 1950s and had a sustained increase even during the world crisis of the mid-1970s. However, since 1978, because of the decrease in the level of producer concentration,

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61/ Le Nickel was a Rothschild Company with a major nickel mine in New Caledonia.

62/ This action permitted Inco to proclaim itself a Canadian company. Tanzer, "The Race for Resources" op. cit., p.157.

63/ "The Nickel Industry and the Developing Countries" op. cit., p.37.

64/ Ibid p.37.

65/ "Preliminary Study in the Non-ferrous Metals Industry", op. cit., p.10.

66/ "The Economics of Nickel", Roshill Information Service Ltd., London, 1981, p.vii.

67/ The prices refer to the United States. The price during that period was stabilized at $771.60 per tonne.

prices have begun to fluctuate[68/], and the London Metal Exchange commenced nickel trading in 1979. The London Metal Exchange now has the major influence in the determination of prices, although most of the larger consumers still fill their requirements by buying directly from the producers[69/].

5. Zinc

Yearly zinc production increased 12.8 times between the average annual production for the period 1875-1899 and the period 1950-1976[70/]. It had a sustained increase in the first years of this century, reaching its peak at the beginning of the First World War. After 1913, there was a decrease in production until the year 1924, when the 1913 level of production was again reached. There was a short period of expansion between 1924 and 1928, and afterwards there was a contraction because of the world economic crisis. In the mid-1930s the level of production was similar to that of the pre-crisis years, with an expansion of production that lasted until the end of the Second World War, followed by a decrease in production in the immediate years after the war.

In the early 1950s, the large expansion in the consumer durable industry, which required numerous die cast parts, and the development of a continuous process to galvanize sheet steel generated a sustained increase in the production of zinc until 1974[71/]. This growth decreased in 1975 because of the decline in automobile production and the increased substitution of aluminium, plastics and stainless steel for zinc in the production of motor vehicles[72/].

68/ "The Economics of Nickel", op. cit.

69/ Robbins and Edwards, "Guide to Non-ferrous Metals and their Markets" op. cit., p.138.

70/ Schmitz, "World Non-ferrous Metals Production and Prices 1700-1976", op. cit., p.7.

71/ AIME World Symposium on Mining and Metallurgy of Lead and Zinc Volume I, 1970, p.4.

72/ The galvanized sheet and strip on the United States automotive market declined from 1,075,056 short tonnes in 1973 to 656,769 in 1975. Source: Annual Statistical Report, American Iron and Steel Institute.

Zinc production in the late nineteenth century was concentrated mainly in the German deposits of Upper Silesia, which was the largest single zinc producing area in the world. In the early 1900s the United States challenged Germany's lead in zinc mining with the development of the tri-state mining regions of Missouri, Oklahoma and Kansas. The development in this period of a new technical process, flotation, permitted exploration of the region of Broken Hill in Australia. After 1930 Canada also became an important zinc producer, with the production coming mainly from the Sullivan Mine in British Columbia, the largest lead-zinc mine in the world in the 1950s. Later the Soviet Union emerged as the second most important producer after Canada[73/].

The degree of concentration of this industry is lower than in the aluminium, nickel and tin industries. Production is basically controlled by forty integrated firms which co-exist with numerous small and medium-size companies[74/].

Zinc prices fluctuated in the first years of the twentieth century. They increased greatly in 1915[75/] and maintained this high level in 1916. After that year there was a sustained decrease in the price level. Prices increased continuously from 1947 to 1952, when they again started to decrease. In the early 1970s prices began to increase until 1975, when they fell again[76/].

The relatively high level of integration of the major firms of this industry has kept a significant amount of the zinc sold from passing through the "free" zinc market, keeping prices to a certain extent under the control of the major producers. Although, the European producer price is used as the basis of supply contracts throughout the world[77/], difficulties arose after

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73/ Schmitz, "World Non-ferrous Production and Prices 1700-1976", op. cit., p.17.

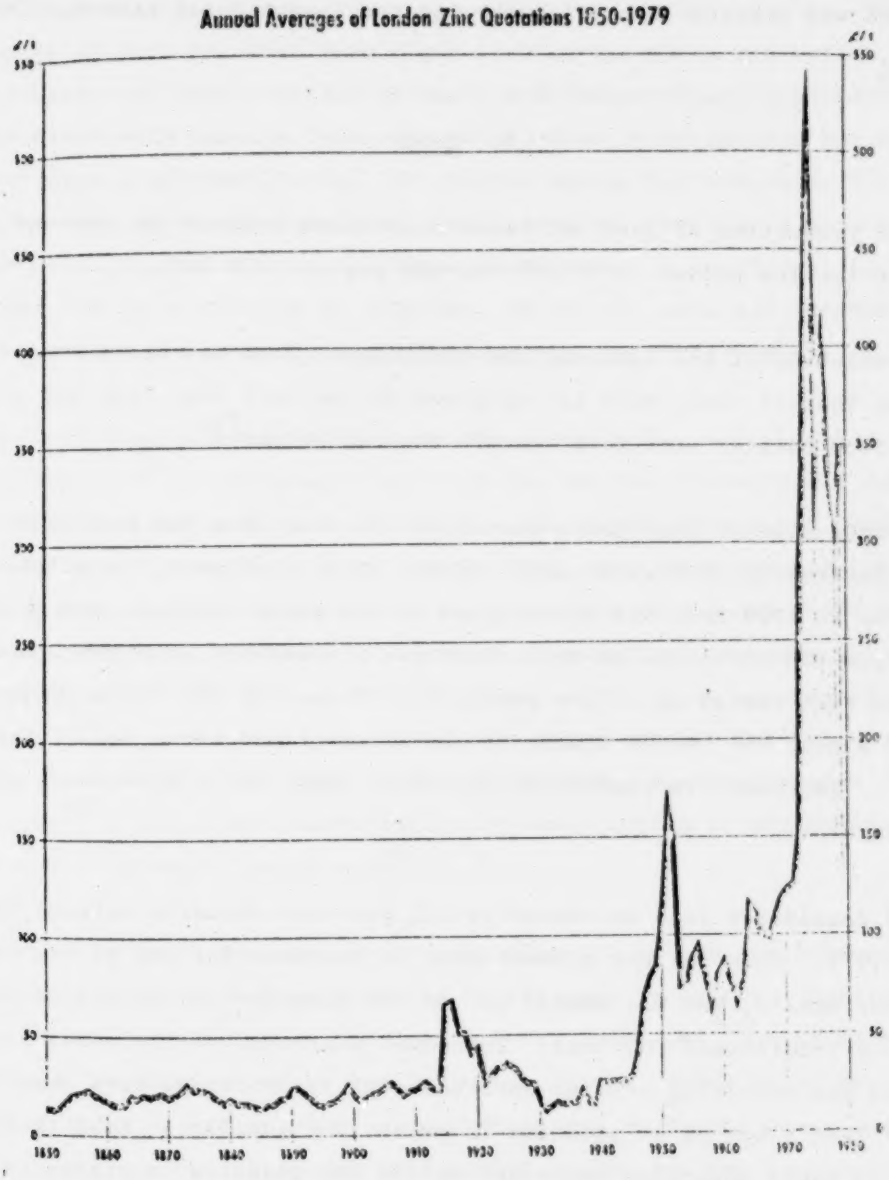
74/ In Europe five groups account for 80 per cent of the processing capacity. These five groups are: Société Générale de Belgique, with subsidiaries in Brazil and the United States, Rio Tinto Zinc, Metallgesellschaft, Preussag and Imetal-Pennaroya.

75/ In the United Kingdom market, the prices increased from £22.07 per tonne to £65.65, in the United States market, from US$ 111.57 per tonne to $287.79.

76/ For further details see Figure 1.

77/ The other producer price quotation is from United States and Canadian producers and applies to the North American Markets.

Figure 1



Source: Metal Statistics 1969-1979, 67th Edition, Metallgesellschaft Aktiengesellschaft.

the emergence of surplus supplies in 1977, with the result that a great degree of interest was created in pricing through the London Metal Exchange free market[78/].

6. Lead

Annual production of lead increased 5.13 times between the average annual production for the period 1875-1899 and the period 1950-1976.

The evolution of the smelting and refining of lead has had a similar pattern to that of zinc; this is explained by the fact that lead and zinc are produced from complex ores that contain the two metals[79/].

The production of lead had a sustained increase from the beginning of 1900 to 1912, decreasing afterwards until 1924. After that year, there was an increase up to 1929 that was interrupted by the world economic crisis of the 1930s. From the mid-1930s to 1942 there was a sustained increase, followed by a decrease that lasted up to the end of the 1940s. In the 1950s production increased again; the United States stockpile programme being one of the main causes[80/]. Increases in production continued until 1975, when there was a slight decrease.

World demand for lead increased by 2.3 per cent annually between 1963-1965 and 1975-1977. This was the slowest rate of increase for any of the major non-ferrous metals, and was mainly due to the decrease in the use of lead in some of its traditional end-uses. Increased awareness of the metal's toxic properties and resulting stiffer environmental restrictions have sharply curtailed lead's use as an additive in paints and gasoline. Substitution of plastics in cable sheathing and other metals and plastics in piping have reduced lead's use in these products[81/].

78/ Robbins and Edwards, "Guide to Non-ferrous Metals and their Markets", op. cit., pp.176-177.

79/ Strong demand for zinc could affect lead and vice versa. For further details see AIME World Symposium on Mining and Metallurgy of Lead and Zinc, op. cit., p.5.

80/ The United States stockpile programme caused the production of lead and zinc to be expanded ahead of consumption. This led to the five year import quota restriction which in turn accentuated the problem of over-supply in other countries, Ibid., p. 14.

81/ Predicasts, Inc., "World Non-ferrous Metals to 1990", Cleveland, Ohio, 1979.

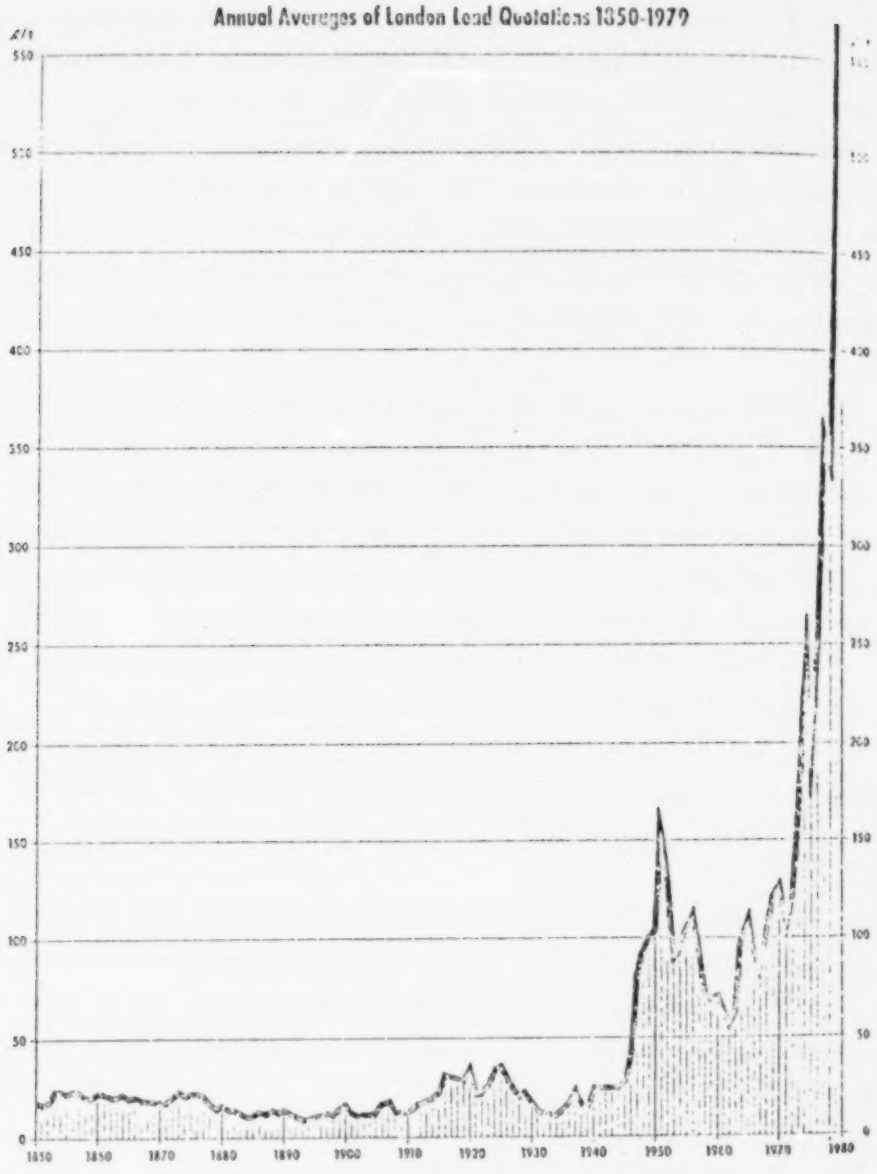
The production of lead is concentrated in relatively few countries (United States, USSR, Australia, Canada, European countries, Mexico, Peru). In the lead industry no firm has more than 8 per cent of the world production, and there is substantial participation by small and medium-sized companies[82/]. During the nineteenth century lead came mainly from Welsh and Pennine mines in Britain and from south-west Spain. The United States has dominated the world market since then, with the development of lead-zinc deposits in Missouri, Kansas and Oklahoma, and Colorado. Major discoveries in the Soviet Union made in the 1930s led to production at Ferghana, in Central Asia and further east in Siberia, making the USSR second in world output by the 1970s[83/].

Lead prices fluctuated greatly up to the early 1970s, and then had a sustained increase[84/]. The evolution of prices in this industry did not necessarily follow the evolution of demand. The prices of refined lead experienced great fluctuations from 1900 to 1920, when they reached their peak. Price fluctuations continued after this until the Second World War, when prices stabilized, followed by a period of sustained increase which was interrupted in the early 1950s. From the early 1950s there were again great fluctuations, with a sizeable decrease in the early 1960s. This price instability lasted until the early 1970s, when prices again increased substantially[85/], this t me caused mainly by heavy buying of the Soviet Union and other socialist countries[86/].

The prices in North America, where lead mine production and primary refining are roughly in balance, are set by the main producers. Outside North America the prices are based on the London Metal Exchange. The primary lead producers have in the past exercised influence in the London Metal Exchange market, often keeping prices up by support-buying. In recent years a large surplus of supplies, the threat of anti-cartel action and the increasing availability of scrap supplies have diminished the capacity of the main producers to control the metal exchange price movements[87/].

82/ See Chapter Three of the present study.
83/ Schmitz, "World Non-ferrous Metal Production and Process 1700-1976", op. cit., p. 12.
84/ Prices decreased in 1975 and 1977.
85/ For further detail see Figure 2.
86/ Robbins and Edwards, "Guide to Non-ferrous Metals and Their Markets", op. cit., p. 118.
87/ Ibid., p. 118.

Figure 2



Source: Metal Statistics 1969-1979, 67th Edition, Metallgesellschaft Aktiengesellschaft.

II. THE EFFECT OF THE WORLD ECONOMIC CRISIS ON THE NON-FERROUS METALS INDUSTRIES

The development of the non-ferrous metals industries in recent years has been influenced by the global economic stagnation, basic changes in the pattern of demand for non-ferrous metals, and changes in the production structure of the industries.

A. Analysis of the main elements that affected the development of the non-ferrous metals industries in the 1970s and early 1980s

1. Global economic recession

The non-ferrous metals industries are very sensitive to fluctuations in the global economy because of their role in the production of intermediate products for the capital goods sector. In the mid-1970s there was a strong deterioration of economic conditions in the developed market economies, as can be seen from the main economic indicators in the following table.

Table 3. Economic Indicators for OECD Countries
(Indices, 1975=100)

	1970	1971	1972	1973	1974	1975
GNP/GDP at 1975 prices (7 major countries)	86.6	90.0	94.6	100.4	100.7	100
Fixed Capital formation at 1975 prices (7 major countries)	93.9	98.3	105.3	113.2	107.0	100
Value of construction output at 1975 prices (7 major countries)	98.3	101.1	104.9	108.2	103.7	100
Index of industrial production (Total OECD)	93.4	92.4	99.7	108.9	109.0	100
Export price indices of primary commodities	33.1	36.4	41.4	59.6	102.2	100
Unemployment rate in per cent (12 OECD countries)				3.0	3.3	5.1
Current balances in million US$ (Total OECD)	6,683	9,734	7,596	9,805	-27,990	-270

Source: IISI/ECON/123.

After a slight improvement from 1975 to 1978, as shown by most of the business cycle indicators in Table 3, a recession began again in 1979. The seven major OECD countries experienced very slow growth of GNP in 1979 and 1980, and a decrease of 0.5 per cent between 1981 and 1982. The estimated GNP growth rate for 1983 is 2.0 per cent, and for 1984 3.2 per cent[88/].

The industrial sector of the OECD countries that are the main consumers of non-ferrous metals products experienced a decrease in production of 0.8 per cent in 1980, a slight growth of 0.7 per cent in 1981 and a considerable decrease of 3.5 per cent in 1982.

Fixed capital formation was particularly weak in the OECD countries in 1982. The European Economic Community as a whole had a decline of 3 per cent in fixed capital formation in 1982, while private fixed investment declined by 5.8 per cent in the United States and by less than 1 per cent in Japan. This decline was a consequence of low profit levels, high interest rates and low rates of capacity utilization[89/]. The low rates of capacity utilization in the developed market economies will negatively affect investment activities in these countries for some time, thus having a negative impact on the level of production in the capital goods sector and on the industries that provide this sector with inputs, such as the steel and non-ferrous metals industries. The OECD countries also suffered a negative balance of trade in 1979, 1980, 1981 and 1982[90/], as well as an increase in unemployment rates[91/]. The

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88/ Source: UNCTAD Secretariat calculations, based on official national and international sources.

89/ The Commission of the European Communities shows that the average rate of capacity utilization in the manufacturing industry of the member countries was only 77 per cent in 1982, lower than the levels of 81.3 per cent and 77.6 per cent observed in 1980 and 1981, respectively. In the United States, according to the Board of Governors of the Federal Reserve System, the rate of capacity utilization in manufacturing was 67.6 per cent during the fourth quarter of 1982, which is below the level of 69 per cent recorded during the 1974-75 recession.

90/ The balance of trade of the OECD countries in 1979 was -6.3 million dollars, in 1980 -31.1, in 1981 -5.3 and in 1982 -0.5 million. Source: OECD Economic Outlook No. 30, December 1981; Economic Outlook No. 32, December 1982.

91/ The unemployment rate was 6.2 per cent in 1980, 7.1 per cent in 1981 and 8.5 per cent in 1982. Source: OECD Economic Outlook No. 30, December 1981; Economic Outlook No. 32, December 1982.

increase in the price levels in these countries was 12.9 per cent in 1980 and 10.6 per cent in 1981[92/].

The economic crisis in the developed countries had a negative impact on economic growth in the developing countries. The volume of exports, which in most of the developing countries are raw materials, was reduced[93/]. Also their terms of trade deteriorated. The prices on the world market of raw materials, excluding oil, decreased in 1982 by 15 per cent. The increase in interest rates as a consequence of the monetary policies of the major OECD countries generated a difficult financial situation in the developing countries, creating a serious obstacle to the implementation of their programmes of investment in the non-ferrous metals industries. The interest payments of developing countries represented 14.5 per cent of their total foreign payments in 1976, increasing to 30.5 per cent in 1980.

The factors mentioned above slowed down the rate of growth of Gross Domestic Product (GDP) in the developing countries considerably. The growth rate decreased from 3 per cent in 1980 to only 0.6 per cent in 1981[94/]. This contrasts with the average growth rate achieved in the 1970s, which was 5.6 per cent[95/].

2. Changes in the pattern of demand

Major changes are occurring in the quantity and quality of the demand for non-ferrous metals products by the main users; this is affecting the level and structure of production in the non-ferrous metals industries. In recent years the demand for virtually all non-ferrous metals has decreased because of the slowing down of the industrial sector world wide and the structural and technological changes in the main industrial activities that use non-ferrous metal products.

92/ The high rate of inflation in the major OECD countries led the governments to establish monetary and fiscal measures that reduced liquidity, thus increasing the rates of interest and substantially reducing government spending. These measures contributed to the reduction of the growth rate.

93/ In 1982 the exports of the developing countries were reduced by 2.5 per cent, and their imports increased by 2 per cent. Source: United Nations, World Economic Survey, 1981-1982, New York, 1982.

94/ The decrease in the GDP was more severe in those developing countries importing oil.

95/ In the developing countries there was a decrease of 1 per cent in the per capita GDP. This had not occurred since the end of the 1950s.

There has been a significant decrease in the growth of the capital goods sector, the main consumer of non-ferrous metal products, over the past few years, as well as changes in its structure caused by the appearance of new technological processes and advances in manufacturing techniques. Particularly those capital goods industries that were until now the main users of both ferrous and non-ferrous metal products have substantially reduced their production. This has been accompanied by a tendency to reduce the weight of non-ferrous metal used in the fabrication of machinery and equipment. At the same time, there has been a considerable increase in new capital goods industries producing equipment for automated manufacturing based on recent developments in electronics, where the use of intermediate metal products are also less per unit of production.

Further, the steel industry, which uses a lot of non-ferrous metal (nickel, zinc), has remained depressed despite a recovery in some areas. Non-ferrous metals are also being replaced by alternative materials, such as plastics, glass fibers, etc. Finally, the increasing need for foreign-exchange earnings by the main developing country exporters of non-ferrous metals is leading them to maintain higher levels of production in relation to demand, thus increasing stocks, which has a corresponding negative impact on prices.

Production of agricultural machinery and heavy equipment for civil works has decreased considerably. There is an over-supply of tractors world-wide and there has also been a drastic reduction of civil works[96/]. The big firms that produce commercial airplanes reduced their production radically in the early 1980s. Production decreased from 323 units in 1979 to 155 in 1980 and 83 in 1981[97/]. Also, the major producers of vehicles for the transport sector had to reduce their production and experienced large losses[98/]. Recently, however, they have begun a process of recovery.

96/ The big enterprises that produce agricultural machinery and equipment for civil works are in economic difficulties, among them: International Harvester, Massey Fergusson, Allis Chalmers, Caterpillar, Clark Equipment, and John Deere.

97/ The estimated production for 1982 was 40 units.

98/ The major United States producers lost approximately 6 billion dollars between 1980 and 1981. L'Expansion, "La Guerre Mondiale des Industries".

The most important capital goods industry, the production of machine tools, has recorded a decline in production in two of the world's largest producers - the Federal Republic of Germany and the United States. The production in these countries fell by about 20 per cent between 1970 and 1977, had a slight increase between 1977 and 1978, and then declined again. The decline in the level of activity in the machine tool industry, one of the industries most responsible for the increases in productivity in the economy, is mainly due to the shifting in the focus of growth in the developed countries from major machine tool-using industries towards electronics and information processing industries which are not important users of machine tools[99/], but which serve to introduce further automation in industry.

Experts anticipate that more than 100 billion dollars will be spent in Western Europe and North America between now and the end of the 1980s on manufacturing automation[100/]. This process of increasing automation has generated an increase in the robot market of more than 25 per cent a year, as well as increases in the markets for computers, control equipment, and especially software. In contrast, the demand for machine tools, as pointed out, has been depressed in most industrialized countries and is unlikely to recover quickly[101/]. Any manufacturer contemplating retooling today prefers to install an automated machining system rather than simple machine tool replacements. Also the objective of such a system is to make fuller use of machines, resulting in the need for fewer machines to do the same amount of work[102/].

The changes in the composition of demand have two main trends. The first, as has been shown, is a tendency towards lower utilization of non-ferrous metals per unit of output in capital goods industries[103/], and the second is a tendency to shift from heavier to lighter non-ferrous metals and to other lighter products.

99/ The main users of machine tools are the automobile industry and the non-electrical machinery industries.

100/ Financial Times, "Manufacturing Automation", January 12, 1984.

101/ Cincinnati Milacron, the largest machine tool manufacturer in the western world lost money for the first time in history in 1983.

102/ Financial Times, "Manufacturing Automation", loc. cit.

103/ The crisis has mainly affected the capital goods industry. The recent world economic recovery has been heavily dependent on consumer goods purchasing. Metal Bulletin, Dec. 30, 1983.

Demand for aluminium in the packaging industry increased with the discovery of new applications for aluminium in food processing and with increased production of aluminium cans. The continued efforts at weight reduction in the manufacture of large commercial vehicles, such as trucks, buses, and trailers, and also passenger cars, have generated a marked shift away from steel to aluminium because of aluminium's lighter weight.

Aluminium is finding new applications in the pace-setter capital goods industries, such as computers, communication equipment and instrumentation, which will tend to increase the growth of aluminium consumption. However, the demand for aluminium in the manufacture of non-electrical machinery has had a slower rate of growth than the other markets[104/].

Copper, which is a relatively heavy metal, has experienced a reduction in demand in the manufacture of vehicles. The trend toward weight reduction is leading to radiators with thinner copper skins and has also led to the substitution of aluminium for copper. The demand for copper in the electrical capital goods industry has been negatively affected by the over-supply of wire and cables. The large wire rod rollers and continuous casting plants built in Europe in the 1970s were constructed mainly for supplying massive electrification projects to the developing countries. When these were not implemented because of the world economic crisis, an over-supply was created that was worsened by the strong competition from optical fibres[105/].

The demand for copper in the construction sector has slowed down because of a recession in that sector, the trend toward multiple housing units which require less copper per unit, and copper's relatively high price in relation to substitute materials.

Nickel, which has a high degree of linkage with the iron and steel industry[106/], has been through hard years because of the significant recession in the steel industry. The decrease and/or slow growth in the production of the different capital goods industries has negatively affected the demand for stainless steel, which uses nickel as an important input.

104/ Predicasts, Inc., "World Non-ferrous Metals to 1990", op. cit., p.9.
105/ Metal Bulletin, December 30, 1983.
106/ 41 per cent of the demand for nickel is to produce stainless steel, 10 per cent for structural alloy steel and 9 per cent for cast iron and steel.

However, there is currently an increase in the demand for stainless steel in the United States, Japan and to a lesser extent in Europe, which will contribute to the recovery of the nickel industry[107].

The main demand for tin, and especially tinplate for the food industry, has decreased because of technical developments that tend to use less tin in the production of tinplate[108], and in the packaging industries that are replacing tin with aluminium. The demand for solder, another main use of tin[109], is low and is expected to grow slowly in the medium term.

The decrease in the level of production of the automotive industry, one of the main users of zinc, greatly reduced the consumption of slab zinc; however, it is increasing again with the recovery taking place in this industry. The other two main users of zinc, galvanized steel production and die casting, do not appear to be booming[110].

In lead, the crisis in the automotive industry and technological developments led to reduced demand for lead for storage batteries. There is a tendency toward smaller, lighter batteries with a longer life, which means that less lead is required per unit[111]. The toxic properties of lead have caused a reduced demand for this metal as an additive in paints and gasoline. The demand for lead has also been reduced by the substitution of plastics for lead in cable sheathing and other metals and plastics in piping. However, there is a trend to increased demand for lead in electronics, auto corrosion applications and as radioactive shielding[112].

107/ Metal Bulletin, October 4, 1983.
108/ 40 per cent of tin production is used in the manufacturing of tinplate.
109/ 28 per cent of tin production is used in the fabrication of solders.
110/ Metals Week, 9 January 1984.
111/ The storage batteries for motor vehicles represent 40 per cent of the demand for lead.
112/ Predicasts, Inc., "World Non-ferrous Metals to 1990", op. cit., pp. 27-29.

3. Changes in the structure of production

The situation in the non-ferrous metals industries can be attributed not only to world economic conditions and changes in the pattern of demand which reduced the elasticity of demand for non-ferrous metals with respect to economic growth[113/], but to a great extent to changes in the supply structure, particularly to the increase in energy prices. As the non-ferrous metals industry is one of the most energy-intensive industrial sectors, the increase in energy prices is generating technological changes, plant closures, and the redeployment of production capacities toward energy-rich countries.

The impact of the increase in energy prices varies among the different non-ferrous metals according to the amount of energy needed in processing them. The primary aluminium industry is the most energy intensive. One tonne of primary aluminium requires about twice as much energy to manufacture as a tonne of copper does, and five times as much energy as an equivalent amount of steel; lead is the non-ferrous metal in which energy requirements are the lowest[114/]. Potential energy shortages and increasing prices will not have as much of an impact on lead production as they will on the other non-ferrous metals; however, refined lead does require 27 million BTU per tonne, which is still a considerable amount[115/].

In aluminium, the sharp increase in fuel costs in 1974 raised the production costs of primary aluminium substantially, bringing about a 36 per cent cost increase in aluminium processing[116/]. Since the second oil shock, power costs have become a dominant factor in production costs. In Japan, the share of energy costs in total production costs has increased from 24 per cent to more than 50 per cent. In the European Economic Community the weighted average power cost paid by smelters increased from 183 dollars per tonne in

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113/ For example the elasticity of aluminium demand with respect to GDP is diminishing over time. It was 2 in the 1960s and it was 1.75 during the 1970s. For further detail see "Aluminium Industry - Energy Aspects of Structural Change", OECD, 1983.

114/ Ibid., p. 17.

115/ Predicasts, Inc., "World Non-ferrous Metals to 1990", op. cit., p. 32.

116/ Ibid., p. 9.

1976 to 266 dollars per tonne in 1978 and 368 dollars per tonne in 1980[117/].

In the non-OECD countries, the impact of the increase in power prices is less because the average power prices are significantly lower, in part explained by the major reliance on hydro power, and in part by the fact that some developing countries maintain low electricity prices as a policy measure designed to attract foreign investment[118/].

The second major problem in the production of refined copper, apart from the main problem which is the low copper content of the ore, is the high energy requirement of copper smelting[119/].

In tin mining the cost of power is a relatively large component, varying significantly between countries. In 1978 in Malaysia, it fluctuated between 7.1 per cent and 26.6 per cent of the total cost, according to the type of the mine. In Thailand in that same year, it represented between 13.4 per cent and 34.3 per cent of total cost. In Australia it was significantly lower, varying from 4.3 per cent to 8.9 per cent[120/].

In nickel, increases in power prices have a significant effect on prices. Estimates indicate that for every 10 per cent increase in the price of fuel oil, there is a corresponding increase of 7 cents per dollar per pound of nickel produced. The increase of fuel oil prices has a greater effect on the cost of producing nickel from laterites than from sulfides. This occurs principally because fuel oil is used to dry wet lateritic ores (containing 25 per cent moisture) and to generate electrical energy used to smelt the dried ore as done in New Caledonia. On the other hand, nickel sulfide ores can be concentrated by flotation techniques, and nickel metal can be recovered with cheaper hydroelectric energy, as is done in Canada and Norway[121/].

117/ In the U.S. Pacific Northwest the hydro-electric rates offered to smelters have increased four-fold since 1979. "Aluminium Industry. Energy Aspects of Structural Change", op. cit., p. 30.

118/ For further details see Ibid., pp. 39-40.

119/ Another major problem of the copper industry is the large amount of sulphur emmitted into the air during the smelting process. Predicasts, Inc., "World Non-ferrous Metals to 1990", op. cit., p. 25.

120/ "Tin Production and Investment", p. 137.

121/ Predicasts, Inc., "World Non-ferrous Metals to 1990", op. cit., p. 32.

In zinc, increases in power prices have a major impact because the energy requirements are extremely high - approximately 65 million BTU per tonne of refined zinc. A problem affecting the production of this metal is the great ammount of sulfur dioxide that is emitted into the air during the smelting process. In lead, as was pointed out, the energy requirements are the lowest of the major non-ferrous metals, but they are still high. The main difficulty in producing lead is environmental. The metal's toxicity causes problems of air pollution, waste disposal and land utilization[122/].

The great impact of power price increases on costs has convinced producers that traditional efforts[123/] to reduce energy costs were insufficient and that there was a need for structural changes. Therefore, the main producers are developing technological changes to reduce energy requirements and thus production costs.

In aluminium, Alcoa is developing a new technological process which involves the chlorination of alumina to produce aluminum chloride and its subsequent electrolyte reduction in a chloride bath. This new process, according to Alcoa, would require 30 per cent less power at the electrolysis stage than the Hall-Heroult cells. However, energy consumption at other stages would be greater, the total saving at all stages being only 15 per cent. Because of the major impact of energy costs on the development of the aluminium industry in Japan, radical technological changes are envisaged in aluminium refining technology. In Japan, efforts are being devoted to the development of a direct reduction process, in which oxygen is separated from bauxite by direct smelting with carbon at very high temperatures. This new technology will reduce the production costs from those of conventional smelters by approximately half[124/].

122/ Predicasts, Inc., "World Non-ferrous Metals to 1990, op. cit., pp. 27-29.

123/ In the short term, reduction of power consumption can be achieved through better management and retrofitting of existing plants.

124/ The introduction of this technology might have an important impact on the development of this industry in the long term, but not in the foreseeable future. For further details see "Aluminium Industry. Energy Aspects of Structural Change", op. cit.

In copper, the impact on costs of power price increases has caused the industry to concentrate on changing the traditional furnace smelting process to continuous smelting techniques, which are more energy efficient. Producers are also introducing technological changes to reduce the amount of sulphur that goes into the atmosphere. For this purpose, producers are constructing more acid-producing facilities and using more hydro-metallurgical conversion which pollutes the air less[125/].

In nickel, technological changes are aimed at recovering a higher percentage of nickel, thus reducing energy costs. These technological changes will mainly make reverberatory smelting and side-blow converter furnaces obsolete. In zinc, to reduce the consumption of energy, there is a gradual replacement of the electrolyte smelting process by the distillation process which has a higher zinc recovery rate and, hence, lower energy consumption per tonne. In lead, technological research has been directed basically towards solving the problems caused by lead's toxicity.

In Japan the increase of energy costs has resulted in the closure of approximately 500,000 tonnes/year of smelting capacity in aluminium, and Japan has become a net importer of some 800,000 tonnes/year of aluminium. In the United Kingdom, the British Aluminium smelter at Fort Williams in Scotland is to be rebuilt to take advantage of the hydropower nearby, and capacity will be raised by one-third, to 37,000 tonnes/year. In the United States, smelters in the Pacific Northwest area that face large power price rises are trying to modernize plants to improve their power supply conditions[126/]. Partly as a result of these impending power cost rises the latest and largest aluminium refinery in the United States has been built at Port La Vaca on the Gulf coast of Texas, close to natural gas supplies.

In France, Pechiney, the third largest aluminium producer in the Western world, is implementing a restructuring programme based on a strategy of producing only where electricity costs are low and only in world-scale plants[127/]. Pechiney is trying to reduce electricity costs in France, and

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125/ All these techniques have had limited application until now. Predicasts, Inc., op. cit., "World Non-ferrous Metals to 1990", p. 25.
126/ "Aluminium Industry. Energy Aspects of Structural Change", op. cit., p.15.
127/ Financial Times, May 4, 1984.

also to cut electricity charges at the group's smelters abroad. Pechiney is involved in a dispute with the Dutch power authorities over electricity charges at the 170,000 tonne smelter in the Netherlands, of which it owns 85 per cent, and has gone to arbitration over power costs at its 140,000 tonne smelter in Greece. Pechiney's biggest overseas investment is in a new 230,000 tonne smelter project in Quebec[128/]; the attraction in Quebec was the offer of exceptionally low power costs in a 25-year contract.

Some governments in developing countries are trying to increase the amount of industrial processing, in order to utilize their their cheap energy resources. Venezuela made use of its cheap source of energy to develop the Venalum plant[129/] to export aluminium ingots to Japan. It is also implementing a project with Alusuisse to exploit the bauxite from Bolivar State. Alcasa, an integrated aluminium plant, is expanding and will roll special flat products.

In Brazil, 30,000 tonnes/year of aluminium production capacity were added in 1978, and further capacity will be added to take advantage of the unique hydro-electric potential and bauxite reserves of the Amazon Basin. Brazil has three new bauxite/alumina - aluminium projects which were moving ahead in 1982, involving a total investment of $4.5 billion. Foreigners will own about 60 per cent, the Companhia Vale do Rio Doce (CVRD) (a largely but not totally state-owned enterprise) 38 per cent, and local Brazilians about 2 per cent. Quantitative analysis indicates that the average projected profit rate of these projects appears to be about 20 to 25 per cent per year. The reason for this high rate of return is the availability of cheap hydro-electric energy and low-cost bauxite supplies.

In the Middle East, none of the developing countries has any indigenous bauxite reserves, but despite this, several primary aluminium plants have been built to take advantage of the cheap energy resources. Primary aluminium capacity already exists in Bahrain, Egypt and Iran and smelters are under construction in Algeria, with further plans in Abu Dhabi, Iraq, Kuwait, Libyan Arab Jamahiriya, Qatar, Saudi Arabia, and Syria[130/].

128/ Pechiney has a 50.1 per cent stake in the project.
129/ Venalum began construction in 1978 and was finished in 1980.
130/ Total output from the plants existing in 1977 was 216,000 tonnes. Metal Bulletin Monthly, April 1979, p. 29.

B. Development of the non-ferrous metals industries in the 1970s and early 1980s

During the 1970s and early 1980s the evolution of the major non-ferrous metals was heavily influenced by the trends in the world economic situation, mainly in the industrial sector[131/]. Consumption in the non-ferrous metals industries generally increased from 1970 to 1974, decreased between 1974 and 1975, recovered from 1976 to 1979, decreased in 1980 to 1982, and began a recovery in 1983.

In general, production followed the evolution of consumption; however, the need of the developing countries for foreign currency caused them to increase production at a faster rate than consumption grew, which increased stocks, mainly in the early 1980s, after their reduction following the recession of 1974-75. For more details see Tables 4, 5 and 6.

Non-ferrous metal prices, after recovering from the effects of the 1974-75 recession, rose steadily - generally reaching their peak in 1979, but then falling in 1981 and 1982. For many of the major non-ferrous metals, real prices in 1982[132/] were the lowest they had been for the last three decades. Prices were below production costs for many producers. In 1983, however, prices recovered[133/].

1. Aluminium

In the 1970s, aluminium production declined only in 1975, as a result of the crisis. However, in the early 1980s the aluminium industry experienced the longest downturn in its history, as a result of the recession in the major consumer goods industries (automobile, construction).

131/ During the 1972-77 and 1978-83 business cycles, metal consumption, production and prices responded to the development in the world industrial sector.

132/ The industrial production of the OECD countries decreased by 3.5 per cent.

133/ See Table 7.

Table 4. World consumption of non-ferrous metals

(Thousands of tonnes)

Consumption	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Primary aluminium	9995.9	10716.9	11800.8	13652.9	13889.3	11350.0	14075.7	14511.2	15342.5	16013.2	15311.8	14533.7	14178.2
Refined copper	7271.1	7288.6	7950.8	8761.7	8339.8	7457.5	8535.8	9030.2	9449.2	9795.3	9385.1	9500.3	9065.9
Refined tin	227.0	228.5	235.4	254.3	244.4	218.9	239.1	230.2	232.8	233.7	222.9	210.9	205.4
Refined nickel	577.3	527.8	566.1	649.4	703.8	576.2	670.3	642.5	699.6	782.6	716.9	655.5	627.9
Slab zinc	5055.9	5164.5	5797.6	6269.5	5995.3	5066.4	5764.4	5819.8	6193.9	6310.6	6131.2	6003.6	5925.4
Refined lead	3871.4	3998.5	4179.9	4441.6	5023.9	4526.2	5013.9	5309.3	5399.0	5628.0	5348.3	5254.8	5246.2

Source: Based on World Metal Statistics

Table 5. World production of non-ferrous metals

(Thousands of Tonnes)

Production	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Primary aluminium	10260.6	10945.1	11647.6	12727.8	13817.5	12835.5	13202.1	14327.1	14745.4	15211.9	16035.3	15697.8	13991.2
Refined copper	7537.7	7338.6	8092.6	8521.5	8903.1	8344.0	8789.8	9100.2	9201.2	9355.0	9389.8	9690.2	9530.7
Refined tin	221.3	229.8	235.0	226.7	222.5	225.7	226.0	224.1	237.1	244.3	224.6	242.9	223.5
Smelter-refined nickel	610.3	619.6	597.3	654.0	716.8	683.7	727.2	702.5	592.9	674.1	742.8	704.1	620.5
Slab zinc	5096.6	5121.8	5554.8	5817.4	5982.3	5472.1	5765.7	5969.8	6057.5	6442.9	6159.0	6190.0	5958.0
Refined lead	4002.7	3939.6	4091.2	4218.9	4924.4	4670.5	4952.3	5241.4	5332.1	5515.6	5424.2	5351.2	5267.8

Source: Based on World Metal Statistics

Table 6. World stocks of non-ferrous metals

(Thousands of tonnes)

Stocks	1975	1976	1977	1978	1979	1980	1981	1982	1983
Primary aluminium inventory at smelters and fabrication plants	3129.0	2322.0	2506.0	2044.0	1515.0	2078.0	3115.0	2936.0	1944.0 a/
Unwrought copper	1743.9	1828.2	1963.8	1534.6	1075.4	1029.4	1086.9	1498.9	1525.7 b/
Refined tin				9.4	8.4	13.5	20.2	38.5	48.8 c/
Unwrought nickel	171.0	179.0	254.3	175.9	140.8	135.6	142.1	117.1	107.6
Refined zinc	1062.4	1026.6	1085.1	664.1	787.7	711.6	817.3	756.4	585.3
Refined lead	568.7	469.9	432.5	354.7	380.9	506.5	489.6	540.3	567.8

Source: Based on World Metal Statistics

a/ November 1983
b/ October 1983
c/ September 1983

Table 7

Prices of Non-ferrous Metals[1/]

	Aluminium		Copper		Tin		Nickel		Zinc		Lead	
	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[3/] Cents per lb.	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[5/] Cents per lb.	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[3/] Cents per lb.	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[5/] Cents per lb.	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[3/] Cents per lb.	London Metal Exchange Cash settlements[2/] £ per metric tonne	US Producer Price[5/] Cents per lb.
1971	N/Q	29.00	444.43	51.43	1437.97	167.35	N/Q	1.33	127.11	16.13	103.93	13.82
1972	N/Q	26.41	427.96	50.62	1506.59	177.47	N/Q	1.40	151.04	17.75	120.73	15.03
1973	N/Q	25.00	726.82	58.85	1962.19	227.56	N/Q	1.53	345.46	20.66	174.58	16.29
1974	N/Q	34.13	877.00	78.77	3498.60	397.27	N/Q	1.74	528.38	35.95	252.88	22.53
1975	N/Q	39.79	566.81	63.25	3092.45	339.82	N/Q	2.07	335.66	38.95	185.63	21.53
1976	N/Q	44.34	782.40	68.98	4256.74	349.24	N/Q	2.26	394.95	37.01	250.70	23.10
1977	N/Q	51.34	750.25	66.21	6185.15	499.38	N/Q	2.28	338.12	34.39	354.11	30.76
1978	N/Q	53.08	710.50	65.81	6710.30	587.03	N/Q	2.08	309.14	30.97	342.79	33.65
1979	756.31	59.40	934.08	92.21	7281.37	713.05	N/Q	2.72	349.86	37.39	567.66	56.64
1980	765.63	69.57	941.75	101.31	7227.21	768.49	2809.57	3.42	327.42	37.43	391.29	42.45
1981	623.51	76.00	865.55	84.21	7088.74	648.40	2951.19	3.43	425.05	44.56	363.37	36.53
1982	567.00	76.00	846.14	72.80	7305.51	586.86	2750.91	3.20	425.47	38.47	310.72	25.54
1983	952.67	77.67	1048.84	77.86	8572.77	601.28	3088.86	3.20	505.82	41.39	279.97	21.68

Source: World Metal Statistics.

1/ Average prices.
2/ Primary ingots, minimum 99.5% purity.
3/ US producer last price as quoted by "Metals Week".
4/ High grade cathodes, prior to 1 December 1981, Wirebars.
5/ US producer cathodes as quoted by "Metals Week", prior to 1973, Wirebars.
6/ Refined tin, 99.7% minimum purity.
7/ New York Dealer Price as quoted in "Metals Week".
8/ Refined Nickel, melting grade.
9/ Producer cathodes as quoted by "Metals Week".
10/ C.O.B. Zinc, 98% minimum purity
11/ High Grade Zinc as quoted by "Metals Week", prior to September 1980 Prime Western delivered.
12/ Refined Pig Lead minimum 99.97% purity.
13/ New York as quoted by "Metals Week".

After a decline of 4.4 per cent in 1980, aluminium consumption fell a further 5.1 per cent in 1981 and 2.4 per cent in 1982. In 1983 there was an upturn. Aluminium production, in contrast, increased by 5.4 per cent in 1980, fell by 2.1 per cent in 1981, and declined sharply in 1982 by 11 per cent. This considerable reduction in production decreased the world-wide capacity utilization rate to 72 per cent[134/], which was the lowest rate ever experienced.

The imbalances between consumption and production, mainly in 1980 and 1981, increased stocks significantly, stock levels in 1981 being similar to those of 1975. These increases in stocks caused a major decline in the level of prices. Prices in the London Metal Exchange fell from £766.53 per metric tonne in 1980 to £567.0 in 1982[135/]. While in the past producers had been able to ensure price stability despite economic and demand fluctuations, mainly through adjustments in stocks, as shown in the 1974-75 recession, in the early 1980s they were unable to do so because of the prolonged economic crisis and the progressive loss of importance of the big six TNCs, which are undergoing major structural changes.

The substantial decreases in prices and simultaneous increases in production costs were particularly marked in the early 1980s because of the rapid rise in electricity costs[136/]. These trends meant that smelters accounting for half the world capacity were unable to cover their costs[137/]. This situation led to cutbacks in production[138/], permanent closures and the merging of some companies. About one million tonnes of high cost capacity have already been permanently closed. Plans for over one million tonnes of new capacity have been cancelled or deferred indefinitely[139/].

134/ The capacity utilization rate was about 60 per cent in the United States, 84 per cent in Europe and less than 30 per cent in Japan.

135/ In 1983 the prices increased.

136/ At the end of 1982 the level of spot prices was almost 30 per cent below the production cost of most aluminium production. The exceptions were producers with low electricity costs, such as Alcan in Canada.

137/ Metal Bulletin, April 8, 1983.

138/ In 1982 Alumax in the US idled 22,000 tpy of capacity. In Japan Showa Aluminium idled another 17,000 mtpy. Alussuise cut back 10,000 mtpy at the 60,000 mtpy Rheinfelden, West Germany, smelter. The company's deepest cuts have come in the United States through its aluminium subsidiary - Reynolds idled 50,000 tpy of capacity at its 13,000 tpy Troutdale, Ore. primary smelter. Alumina Italia reduced 20 per cent of its 280,000 mtpy Italian capacity. Metals Week, June-July, 1982.

139/ Metal Bulletin, April 8, 1983.

In 1983 the aluminium situation improved, mainly due to the industrial recovery in the United States, which was based on the increase in the production of consumer durable goods, where aluminium is used much more than the other non-ferrous metals[140/]. This recovery raised prices[141/], making it once more profitable for the producers to use their idle capacity and to continue projects which had been shelved during the years of recession. In the United States the capacity utilization levels were back up to more than 80 per cent, from approximately 60 per cent in 1982[142/]. In Japan, domestic primary producers continued producing at a rate of only 300,000 - 350,000 tpy, despite reasonably good demand. Imports continued to supply the bulk of the country's aluminium requirements, although an increasing proportion came from overseas joint ventures with countries such as Venezuela and Indonesia and long-term contracts with countries such as Australia, rather than spot purchases from Western merchants[143/]. In Australia, the improvement in market conditions restored the viability of projects that were put aside during the years of recession[144/].

2. Copper

The great responsiveness of the major end-users of copper (electrical capital goods, construction and transport industries) to changes in the level of economic activity, makes the copper industry especially sensitive to the developments in the economy, especially in the industrial sector[145/].

The consumption of copper decreased in the 1974-75 recession, recovered afterwards and reached its peak in 1979. As the world economic recession intensified, the consumption of refined copper declined by 4.5 per cent in 1980, increased slightly in 1981, and decreased again by 4.6 per cent in 1982.

140/ Metals Week, 9 January 1984.

141/ There are fears that these price increases will weaken aluminium's position against other competitive metals and plastics. In 1983, for the first time, the price of aluminium was higher than that of copper.

142/ Metal Bulletin Monthly, April 1984.

143/ Ibid.

144/ The new Tomago smelter came on stream just when the market most needed the metal. Ibid.

145/ Estimates of the elasticity of economic activity with respect to demand for copper often exceed unity.

Copper production continued to increase in 1980 and 1981 despite the decrease in consumption; in 1982 the production of refined copper declined by only 1.7 per cent.

The widening supply-demand imbalance was due to two factors: efforts by developing countries[146/] to compensate drops in prices with increases in output to maintain their foreign exchange earnings, and the easy availability of cheap, good quality scrap. As a result, total stocks of refined copper increased to 1.5 million tonnes in 1982, equivalent to about two months' consumption. Stocks in 1982 stood at their highest level since 1978.

Copper prices, after declining considering in the recession of 1974-75, rose rapidly, reaching their peak in 1980. They fell in 1981 and 1982 as a result of the economic recession and the continuous increase in stocks.

The reduction of prices in 1982 caused major closures. Falconbridge Copper, a Falconbridge subsidiary, closed its Lake Du Fault copper mine at Noranda, Quebec. The depressed copper market conditions forced Kennecott to close its 100,000 tonnes per year Ray Mines at Hayden, Arizona, Noranda to shut its Bell mine in Northwestern British Columbia, Quintana Mining closed its Copper Flat mine east of Hillsboro, New Mexico, etc.

In 1983, although two important outlets for copper - the automobile and construction industries - were experiencing increases in activity in the United States, world consumption of refined copper in the first nine months was roughly 2 per cent less than during the same period in 1982. Regarding refined production, however, preliminary figures for the first nine months of 1983 pointed to an increase of 2.5 per cent compared with the corresponding period in 1982[147/]. Consequently, world commercial stocks of copper rose to 1.53 million tonnes at the end of September 1983[148/].

146/ Mainly Chile, Zaire and Zambia.

147/ "Recent Developments and Outlook for Primary Commodity Markets", International Monetary Fund, April, 1984.

148/ There was a brief period in June - July 1983 when stocks fell because China bought 200,000 tonnes.

The real worry for copper producers is that the buildup of stocks occurred at a time when markets should have been recovering because of the recovery in the United States' industrial activity and the cutbacks in production by North American copper producers[149/]. These cuts in output, however, particularly at high-cost United States plants, were offset to a large extent by increases in production in other places in the world. Chilean production continues to increase, Australia continues to produce at near normal levels, and developing countries in general made efforts to make up for the drop in prices by increasing output[150/].

In 1983, copper prices, after starting on a high note, appeared to be accelerating towards record levels, but the market crumbled and by October prices were down to the previous year's depressed conditions.

3. Tin

Tin consumption has been experiencing a long-term downward trend since 1974, mainly because of the increasing substitution of other materials, such as aluminium for tin in the canning industry. This downward trend has been aggravated since 1979 as a result of the recession in industrialized countries, which account for approximately 85 per cent of total world tin consumption[151/]. World production of tin has fallen by less than demand[152/], resulting in an increase in the world commercial stocks of refined tin, from 4 per cent of annual consumption in 1978 to 18.7 per cent in 1982.

Tin prices were sustained by the constant support buying for the buffer stocks of the International Tin Agreement (ITA), and also by its export restrictions that kept at least some of the world over-production off the market[153/].

149/ In 1983 new cuts in production were made in the United States, such as the suspension of production by Anamax at its Twin Butler, Arizona, copper mine; Anaconda Mineral of its operations at its Butte, Montana, copper mine; Kennecott at its copper refinery in Anne Arundel County outside Baltimore and its McGill, Nevada, copper smelter, etc.

150/ Metals Week, 9 January 1984.

151/ Consumption of refined tin declined 4.4 per cent in 1980, 5.1 per cent in 1981 and 2.4 per cent in 1982.

152/ Production increased slightly from the recession of 1974-75 up to 1980, having a small reduction of 0.7 per cent in 1981 and a decrease of 8 per cent in 1982.

153/ Metal Bulletin, December 30, 1983.

World consumption of primary tin was less in the second quarter of 1983 than it had been in the same period of the previous year. The reduction in production for the period was even greater[154/]. There were important decreases in output in Bolivia and Malaysia because of cutbacks in existing production capacity, and also because of the exhaustion of existing deposits and the small expansion of scarce new reserves[155/]. In 1983 in Bolivia there were production cutbacks of approximately 50 per cent in the Huanuni district, one of Bolivia's major tin mining areas. Also, ENAF, Bolivia's state smelting company, shut down its 20,000 tonnes per year high-grade tin smelter in Vinto, Orura. In 1982 the smelter's output was some 15 per cent below normal capacity because of a shortage of feed-stock[156/]. In Malaysia the total output in 1982 declined approximately 13 per cent from the 1981 production of 59,938 tonnes[157/]. Elsewhere, low prices have discouraged investments and also brought about cutbacks[158/].

4. Nickel

During the end of the 1960s and the beginning of the 1970s there were significant changes in the pattern of consumption of nickel, mainly as a result of a shortage of supplies caused by a long strike at the Canadian Mines of Inco and Falconbridge, which forced consumers to look for substitutes for nickel or alternative sources of supply[159/]. The level of consumption of refined nickel stayed practically the same from 1970 until 1972; it increased in 1974, but the world economic recession of the mid-1970s reduced it again in 1975 to the level of 1970. After the recession, nickel consumption began to increase because of an increase in the demand for nickel alloys - mainly in Japan for electronic components, and also increases in the level of nickel consumption for producing stainless steel. The consumption of nickel decreased after 1979 because of the world economic recession. In 1980 the consumption of refined nickel declined by 8.4 per cent, in 1981 by 8.6 per cent and in 1982 by 4.2 per cent.

154/ International Tin Council, Quarterly Statistical Bulletin, March 1984.
155/ Asia 1984 Yearbook, Far Eastern Economic Review.
156/ Metal Bulletin, 6 May 1983.
157/ Metal Bulletin, 22 February 1983.
158/ In 1982 Kennecott closed its McGill, Nevada, 90,000 tonne per year smelter. Also the Cornish South Crofty tin mine in 1983 cut its normal output by 25 per cent.
159/ Robbins and Edwards, "Guide to Non-ferrous Metals and their Markets", op. cit., p. 137.

The production of smelter-refined nickel, after declining in 1972 and 1975, experienced a recovery that was interrupted in 1977 and 1978 by the cutbacks in production by Canada, which had been until then the world's largest nickel smelter. Nickel production reached its peak in 1980, to decline afterwards by 5.2 per cent in 1981 and 11.9 per cent in 1982.

After the recession of the mid-1970s, nickel stocks attained their peak in 1977, maintaining a level that was equivalent to approximately 4.7 months of consumption. Afterwards, there was a reduction in stocks because of cutbacks in production by Canadian producers, but they increased again in 1980 and 1981 because of growing imbalances between supply and demand as production rose faster than consumption. Beginning in 1982, the surplus stocks have been reduced by cutbacks by major Canadian producers and also New Caledonian and Australian producers[160/].

Nickel prices, which until 1979 were producer prices, did not suffer from the world recession of the mid-1970s. However, in 1978 they decreased and began to fluctuate considerably, due to the prolonged crises of this industry, expressed in the high level of stocks in 1977. Producer prices in the United States in 1980 and 1981 increased in relation to 1979, but decreased again in 1982 and 1983 despite the reduction in the level of stocks and the cutbacks in production of the major producers[161/]. The London Metal Exchange price of nickel increased in 1983.

In 1983, after three successive years of decline, nickel consumption increased in the market economies[162/]. The United States is expected to lead the recovery with a 20 per cent increase in consumption over the very low 1982 levels, while European consumption grows by 4 per cent and Japanese consumption remains constant[163/].

160/ Metals Week, 9 January 1984.

161/ In 1982 Inco halted nickel production for four months at its Sudbury, Ontario, divisions and closed its Thompson, Manitoba, facility for two months. In 1983 it also closed its Port Colborne, Ontario operations for five weeks. In 1982 SLN reduced its ferro-nickel production at Doriambo, New Caledonia, so that projected 1982 output had fallen to 33,000 million tonnes. Metals Week, 12 July 1982. In 1983 Marinduque Mining and Industrial Corporation shut down operations at its nickel refinery at Surigao in the Philippines.

162/ World nickel consumption is projected to increase approximately 6 per cent in 1983, according to Amax Nickel.

163/ Metal Bulletin, 18 November 1983.

5. Zinc

The consumption of zinc decreased in 1974-75, recovered up to 1979, and declined again by 2.8 per cent in 1980, 2.1 per cent in 1981 and 1.3 per cent in 1982. This was due largely to the reductions in industrial production, mainly motor car production, and construction output of the main industrial countries[164/].

The production of zinc declined only in 1975, and by a lesser amount than consumption, as a result of which the stocks increased to an amount equal to approximately 2.5 months of consumption. Beginning in 1979, production was reduced by more than consumption. Production decreased by 4.4 per cent in 1980, increased slightly in 1981, and decreased in 1982 by 3.7 per cent.

This substantial decrease in production was due to production cutbacks by the major producers such as Asarco[165/], and also by the Western European smelters that produce a significant proportion of the world's zinc metal output using zinc concentrates bought from mine producers. The European zinc industry was implementing planned capacity shutdowns that continued to be in evidence throughout 1983.

The important cutbacks in production have contributed to a significant reduction in stocks, which in 1983 were approximately 45 per cent less than their 1975 level.

164/ The industrial production index in the United States (1980 = 100) declined from 104 in 1979 to 94 in 1982. The motor car production declined from a monthly average of 702 thousand vehicles in 1979 to 421 thousand in 1982. In the construction industry, an index referring to the value of contracts (1980 = 100), decreased fom 115 in 1979 to 103 in 1982. In France the index of industrial production declined from 100 in 1979 to 98 in 1982 and motor car production decreased from an average of 311 thousand cars in 1979 to 257 thousand in 1982. Similar reductions of industrial production were observed in Germany and the United Kingdom. The exception was Japan, which had a slight increase in its industrial production. Lead and Zinc Statistics, Monthly Bulletin of the International Lead and Zinc Study Group, March 1984.

165/ In 1982 Asarco suspended production at its Corpus Christi, Texas electrolytic zinc refinery.

Zinc prices increased considerably until 1974, when they reached their peak price for the 1970s. In 1975 they decreased significantly as a consequence of the world recession. Prices remained relatively low up to 1980 because of the high level of stocks. In 1981 there was a substantial increase in the level of prices largely because of a rather tight supply situation brought about by lengthy strikes in certain major producing countries[166/].

In 1983 the market changed from weak to strong. The United States slab zinc consumption rose 13 per cent during the first quarter of 1983 in relation to the comparable period of 1982[167/]; in Japan there was a strong rise in zinc demand, mainly due to an increase in the consumption of galvanized steel sheets and brass. In Europe conditions remained sluggish due to over-capacity. The large amounts of zinc bought by China were also a key aspect of the the improvement in market conditions. This recovery generated a steady increase in prices in 1983, and they continued to increase in the first quarter of 1984. A continous recovery in zinc prices is expected for all of 1984.

6. Lead

The consumption of lead in the 1970s increased up to 1974, but decreased by 10 per cent in 1975. After the world recession of the mid-1970s it increased again, reaching its peak in 1979, mainly due to the unprecedented buying by the Soviet Union[168/], and also to the severe winter in 1979 in the industrialized countries, which generated frequent replacements of batteries, the major lead end-use. Since 1979 the consumption of lead has decreased. In 1980 the consumption fell 2.8 per cent, in 1981, 1.7 per cent and in 1982, 0.2 per cent.

166/ "Recent Developments and Outlook for Primary Commodity Markets." International Monetary Fund, April, 1984.

167/ Metals Week, July 4, 1983.

168/ J.M. Cigan, T.S. Mackey, T.F. O'Keefe "Lead - Zinc - Tin 80", Metallurgical Society of AIME, New York, 1979, p.4.

The production of refined lead, having increased in the early 1970s, decreased in 1975 by 5.2 per cent; this was much less than the decline in consumption so stocks increased to about 1.5 months of consumption. This imbalance of supply and demand had a strong impact on the price, which had been steadily increasing since the early 1970s, but which then fell by 26.6 per cent in 1975.

Production of refined lead recovered after 1975, reaching, as did consumption, its peak in 1979. In that year purchases by the Soviet Union pushed prices artificially high at a time when there was no world scarcity of lead. Production declined, decreasing 1.7 per cent in 1980, 1.3 per cent in 1981 and 1.6 per cent in 1982.

The early 1980s have been characterized by a persistent excess of supply of lead over demand that has generated an increase of the stocks to levels similar to the recession of the mid-1970s. This over-supply has made prices fall significantly from the peak reached in 1979. Prices in the London Metal Exchange decreased 31.1 per cent in 1980, 7.1 per cent in 1981, and 14.5 per cent in 1982.

Depression was the hallmark of the lead market in 1983. The upturn in the world economy did not generate an increase in consumption, which was virtually static[169/]. This was accompanied by unprecedentedly high stock levels which made prices decline by a further 9.9 per cent in relation to 1982. In 1983 selling prices were below the cost of production for most of the producers[170/]. This caused some closures, such as that of the lead mine and concentrator in Sweetwater, Missouri owned by Ozark Lead Company[171/], and the lead production at Berzeluis Metallhutter's 80,000 tonnes per year Stolberg smelter[172/].

169/ Metal Bulletin Monthly, April 1984.
170/ Metals Week, 9 January, 1984.
171/ Metal Bulletin, March 4, 1983.
172/ Metal Bulletin, January 31, 1984.

III. THE STRUCTURE OF THE NON-FERROUS METALS INDUSTRIES

The mining and processing of non-ferrous metals is of significant importance to developing countries because for many of them it is responsible for a large share of their gross domestic product (GDP) and is a source of foreign currency that is needed for internal economic development. In addition, the non-ferrous metals are crucial because of the major role that they play or could play in the development of the capital goods industry and other key sectors (construction, transport), by providing these sectors with the basic inputs needed. Table 8 presents selected developing countries for which the share of the mining sector is above 10 per cent of the GDP, and Table 9 indicates those developing countries in which the total value of ore and metal exports is more than 5 per cent of the total exports.

The main characteristics of structure of the non-ferrous metals industries are the following:

a) The structure of the non-ferrous metals mining and processing industries depends to a great extent on the growth and logic of development of the capital goods sector. Metals such as aluminium and nickel, because of their characteristics (light weight, etc.), are more linked with the present pace-setter capital goods industries, while the others are linked with the more traditional capital goods industries and with other sectors of the economy;

b) The developed market economies, which are the main producers of capital goods, are the major consumers of non-ferrous metals, mainly aluminium and nickel. These countries are also the major processors of the ores, although they are not the main mining producers.

c) The developing countries only participate to a small extent in world consumption and processing of non-ferrous metals, despite their major share in mining production. The development of their non-ferrous metals industries is externally oriented, which is reflected in the high share of exports in their total production of non-ferrous metals.

d) The centrally planned economies have a low participation in world trade compared with the other groups of countries, because their production is mainly oriented towards satisfying domestic demand.

e) The non-ferrous metals industries are highly concentrated. In the cases of aluminium and nickel, where the concentration is highest, production is mainly in the hands of TNCs. In the other metals the level of concentration is lower and there is a significant amount of participation by developing country state enterprises (copper, tin) and by small and medium-sized enterprises (zinc, lead).

1. Mining production

A large share of the mining production of non-ferrous metals is in developing countries. The largest share is for tin, with 76.8 per cent of the total production of 1980; for bauxite it is 50.5 per cent; and for copper it is 43.9 per cent. The developed market economies are major mining producers of zinc (51.5%), lead (46.5%) and nickel (39.8%). However, the developing countries also have a relatively large share of mining output for the latter group of minerals[173/]. The share of the centrally planned economies in mining production is lower than that of the other groups of countries. Their share of world production in 1980 was 21.7% of zinc, 21.0% of lead, 20.7 per cent of nickel, and 20.3% of copper. Their share in the production of bauxite is only 10.8 per cent and in tin it is 8.2 per cent. Tables 10 and 11 present world mining production and the structure according to different groups of countries.

2. Consumption

The developing countries, despite their importance in mining production, have a relatively low share in metals consumption, mainly because of their small internal markets. This is due to the relatively low development of the sectors that are the main users of processed minerals, primarily the capital goods sector. In 1980, the developing countries participated to a significant

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173/ Their share is 34.6 per cent in nickel, 22.7 per cent in zinc, and 24.3 per cent in lead.

extent in the global consumption of slab zinc (13.4%), refined lead (11.3%), and refined tin (10.3%). They consumed only 9.2 per cent of world supplies of primary aluminium, 8.9 per cent of refined copper and 5.7 per cent of refined nickel.

The developed market economies are the main consumers of non-ferrous metals because of their dominant share in world production in the capital goods and transport sectors. In 1980 these countries consumed approximately 68.2 per cent of primary aluminium, 67.9 per cent of refined nickel, 65 per cent of refined copper, 64.5 per cent of refined tin, 60.6 per cent of refined lead, and 57.1 per cent of slab zinc.

The centrally planned economies also have a higher level of consumption of non-ferrous metals than do the developing countries. They have a relatively important share in the consumption of slab zinc (24.3%), refined nickel (23.8%), refined lead (22.9%) and refined copper (20.1%). Their share in the consumption of primary aluminium and refined tin is lower. They consume 18.1 per cent of refined tin and 17.7 per cent of primary aluminium. Tables 12 and 13 show the metals consumption and its structure by the different types of countries.

3. Processing output

The participation of the developing countries in industrial production is insignificant compared to their contribution in mining output. This is a result of the low level of integration that these countries have between mining activities and industrial processing operations. Tin is the only metal in which the developing countries participate to a large extent in processing output, a result of tin's historical evolution, which was touched upon in Chapter 1. In 1980 the developing countries accounted for 70.7 per cent of the world production of refined tin, a share similar to their contribution to mining output. In the case of copper, the share of developing countries was only 23.2 per cent, which, in percentage terms, is only slightly less than half their share of total mining output. In the production of smelter-refined nickel, they participated with 15.3 per cent, in refined lead with 13.5 per cent, in slab zinc with 12.2 per cent, and in primary aluminium with 10.7 per cent. For all these metals the share of developing countries in percentage terms was less than one half of their share of world mining output.

Table 8. Share of the mining sector in total GDP for selected countries in 1977[a/]

(Percentage)

Country	Share
Bolivia	10.6
Ecuador	11.8
Guinea	18.0
Guyana	16.6
Jamaica	10.5
Kiribati	42.6
Liberia	22.8
Mauritania	17.2
Namibia	31.6
New Caledonia	25.9
Papua New Guinea	13.4
Suriname	26.6
Togo	11.9
Trinidad + Tobago	39.5
Yugoslavia[b/]	40.0
Zambia	11.4

Source: UNCTAD secretariat, Handbook of International Trade and Development Statistics, Supplement, 1980. (Table 6.10)

a/ Includes the whole mining sector, not only non-ferrous mining.

b/ Share of the mining sector in the total Gross Material Product.

Table 9. Share of minerals and metals in the total value of exports of selected developing countries:

(Countries where the share is greater than 5 per cent of total exports)
(Percentage)

Country	Year	Share
Angola	1975	8.45
Bahrain	1978	9.57
Bolivia	1975	47.99
Brazil	1979	14.97
Cape Verde	1978	17.93
Chile	1977	65.18
Congo	1977	6.01
Dominican Rep.	1979	19.66
Egypt	1979	5.59
Gabon	1977	9.35
Ghana	1977	12.45
Guyana	1977	38.09
Haiti	1977	12.17
Honduras	1977	6.52
India	1977	14.30
Jamaica	1977	21.68
Jordan	1978	32.00
Kiribati	1974	79.42
Korea, Rep. of	1978	5.52
Lebanon	1973	5.55
Liberia	1978	62.75
Madagascar	1978	5.50
Malaysia	1977	12.45
Mauritania	1975	90.08
Mexico	1977	12.68
Morocco	1978	40.24
New Caledonia	1979	87.67
Niger	1976	64.23
Papua New Guinea	1976	59.87
Peru	1977	53.28
Philippines	1978	14.53
Rwanda	1976	8.74
Senegal	1975	24.49
Sierra Leone	1975	15.32
Suriname	1975	30.99
Thailand	1978	11.52
Togo	1977	49.36
U.R. Cameroon	1979	5.08
Yugoslavia	1979	10.96
Zaire	1975	70.67
Zambia	1977	97.76

Source: UNCTAD secretariat, Handbook of International Trade and Development Statistics, Supplement, 1980. (Table 4.1)

The developed market economies produce a large share of global processed output of non-ferrous metals, more than 50 per cent of all metals except tin. Their percentage share in processed output of all metals are much higher than their shares in global mining output. In 1980 these shares were: 68 per cent of world production of primary aluminium, 61.6 per cent of the production of refined lead, 60.7 per cent of slab zinc, 57 per cent of smelter-refined nickel, 50 per cent of refined copper and 14.5 per cent of refined tin.

The shares of the centrally planned economies in processed metals are similar to their shares in mining of these metals. The only exception is aluminium, where their share in processed output is much higher than their share in the production of bauxite. The participation of these countries in world processing output of each of the various non-ferrous metals is approximately 20 per cent, with the exception of tin which is only 7.8 per cent[174/]. Table 14 presents the processing output of non-ferrous metals and Table 15 the shares produced by the different groups of countries.

4. Exports and Imports

Developing countries participate with relatively large shares in total world exports of two non-ferrous metals, refined tin (86.5%) and refined copper (61.8%). Their shares in total exports of the other metals is significant, but much lower than the shares of these two metals. Their shares in exports are 21.5 per cent of lead, 20.6 per cent of aluminium, 17.5 per cent of nickel, and 16.9 per cent of zinc. The share of the developing countries in total world imports is much smaller than in the case of the exports. In all metals their share is less than 20 per cent[175/].

174/ The shares of centrally planned economies in 1980 in processing output were 23.7 per cent in nickel, 23.2 per cent in zinc, 21.7 per cent in copper, 20 per cent in lead and 18.1 per cent in aluminium.

175/ The figures refer to 1982. The shares of the developing countries in total world imports of processing output in 1982 were the following: 19.1 per cent of zinc, 12.5 per cent of lead, 11 per cent of copper, 5.8 per cent of aluminium, and 3.1 per cent of nickel.

Table 10. Mining output of non-ferrous metals (Thousands of tonnes)

	Bauxite		Copper		Tin		Nickel		Zinc		Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980
Developing countries	35,493.3	47,094.3	2,749.0	3,457.7	174.7	177.3	192.4	259.4	1,293.7	1,399.6	866.0	873.3
Latin America	25,618.4	25,143.3	1,032.1	1,619.8	37.7	31.2	57.6	63.1	737.0	902.8	458.6	418.9
Asia	4,036.3	3,954.1	265.7	464.5	122.0	136.8	14.5	79.0	253.6	268.9	146.7	183.8
Africa	3,641.6	14,858.9	1,224.1	1,106.8	15.0	9.3	12.2	30.2	206.4	132.6	140.5	149.1
Oceania	-	-	124.0	146.8	-	-	108.1	86.6	-	-	-	-
Other	2,197.0	3,138.0	103.1	116.8	-	-	-	0.5	96.7	95.3	120.2	121.5
Centrally Planned Economies	10,651.5	10,060.0	1,271.7	1,597.8	13.2	19.0	113.4	155.3	1,161.9	1,336.4	753.0	754.9
USSR	7,400.0	6,400.0	1,030.0	1,130.0	12.0	17.0	110.0	143.0	800.0	1,000.0	530.0	580.0
Europe	3,251.5	3,660.0	241.7	467.8	1.2	2.0	3.4	12.3	361.9	336.4	223.0	174.9
Developed Market Economies	22,520.5	34,471.5	2,705.1	2,382.6	17.6	16.4	302.2	297.7	3,226.4	3,179.1	1,773.6	1,673.4
USA	1,841.1	1,559.0	1,510.3	1,181.1	-	0.1	15.3	13.3	476.8	348.5	584.9	561.6
Europe	5,771.0	5,210.5	155.1	167.7	4.7	4.0	16.5	21.6	688.9	1,015.2	344.3	365.0
Japan	-	-	112.1	52.6	0.9	0.5	-	-	281.1	238.1	63.4	44.8
Canada	-	-	719.7	716.4	-	0.2	234.9	188.5	1,271.6	1,058.7	376.3	296.6
Australia	14,437.0	27,179.0	185.8	243.5	12.0	11.6	35.5	74.3	507.1	495.3	396.0	397.6
Other	471.4	523.0	22.1	21.3	-	-	-	-	20.9	23.3	8.7	7.8
China	550.0	1,700.0	129.0	177.0	23.0	16.0	-	11.0	110.0	150.0	125.0	160.0
Other Africa	-	-	187.4	251.1	3.0	2.4	11.7	25.7	44.3	107.1	59.0	133.8
Other	-	-	2.5	0.5	-	-	6.2	0.2	-	-	-	-
World Total	69,215.2	93,325.8	7,044.7	7,863.7	231.5	231.1	625.9	749.3	5,836.3	6,172.2	3,576.6	3,595.4

Source: Constructed on the basis of statistical information from Monthly World Metal Statistics published by World Bureau of Metal Statistics.

Table 11. Structure of mining output of non-ferrous metals (Percentage)

	Bauxite		Copper		Tin		Nickel		Zinc		Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980
Developing Countries	51.3	50.5	39.0	43.9	75.5	76.8	30.7	34.6	22.2	22.7	24.2	24.3
Latin America	37.0	26.9	14.7	20.6	16.3	13.5	9.2	8.4	12.6	14.6	12.8	11.7
Asia	5.8	4.3	3.8	5.9	52.7	59.2	2.4	10.5	4.3	4.4	4.2	5.1
Africa	5.3	15.9	17.4	14.0	6.5	4.1	1.9	4.1	3.5	2.2	3.9	4.2
Oceania	-	-	1.7	1.9	-	-	17.2	11.6	-	-	-	-
Other	3.2	3.4	1.4	1.5	-	-	-	-	1.8	1.5	3.3	3.3
Centrally Planned Economies	15.4	10.8	18.1	20.3	5.7	8.2	18.1	20.7	19.9	21.7	21.1	21.0
USSR	10.7	6.9	14.6	14.4	5.2	7.4	17.6	19.1	13.7	16.2	14.8	16.1
Europe	4.7	3.9	3.5	5.9	0.5	0.8	0.5	1.6	6.2	5.5	6.3	4.9
Developed Market Economies	32.5	36.9	38.4	30.3	7.6	7.1	48.3	39.8	55.2	51.5	49.6	46.5
USA	2.7	1.7	21.5	15.0	-	-	2.4	1.8	8.2	5.6	16.4	15.6
Europe	8.3	5.6	2.3	2.2	2.0	1.7	2.6	2.9	11.4	16.4	9.6	10.2
Japan	-	-	1.6	1.0	0.4	0.3	-	-	4.8	3.9	1.8	1.2
Canada	-	-	10.3	9.1	-	-	37.6	25.2	21.8	17.2	10.5	8.2
Australia	20.8	29.0	2.7	3.0	5.2	5.1	5.7	9.9	8.7	8.0	11.1	11.1
Other	0.7	0.6	-	-	-	-	-	-	0.3	0.4	0.2	0.2
China	0.8	1.8	1.8	2.3	9.9	6.9	-	1.5	1.9	2.4	3.5	4.5
Other Africa	-	-	2.7	3.2	1.3	1.0	1.9	3.4	0.8	1.7	1.6	3.7
Other	-	-	-	-	-	-	1.0	-	-	-	-	-
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Table 10.

Table 12. Non-ferrous metals consumption in different groups of countries

(Thousands of tonnes)

	Primary Aluminium		Refined Copper		Refined Tin		Refined Nickel[1]		Slab Zinc		Refined Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972[4]	1980	1972	1980
Developing Countries	755.3	1412.4	439.4	836.3	17.9	23.0	12.9	41.1	551.8	818.6	379.8	604.5
Latin America	323.5	597.9	257.2	495.7	6.8	11.0	4.9	16.9	240.3	344.0	200.8	267.3
Asia	308.6	553.1	84.1	192.1	8.9	9.4	3.0	16.4	224.0	342.9	101.0	168.9
Africa	34.5	93.2	14.9	25.9	1.4	1.6	4.0[3]	6.1[3]	25.0	58.6	23.0	40.0
Oceania	-	-	-	-	-	-	-	-	-	0.1	-	-
Other	88.7	168.2	83.2	122.6	0.8	1.0	1.0	1.7	62.5	73.0	55.0	128.3
Centrally Planned Economies	2,083.5	2,710.8	1,430.0	1,887.8	33.0	40.3	125.3	170.8	1,200.6	1492.0	913.1	1222.4
USSR	1,445.0	1,850.0	1,030.0	1,300.0	18.0	24.5	100.0	132.0	840.0	1030.0	560.0	800.0
Europe	638.5	860.8	400.0	587.8	15.0	15.8	25.3	38.8	360.6	462.0	353.1	422.4
Developed Market Economies	8,661.4	10,432.0	5,766.3	6,100.6	168.3	143.7	405.9	487.0	4,235.5	3,498.1	2,681.2	3242.7
USA	4,298.8	4,453.5	2,029.9	1,867.7	56.6	46.5	144.5	141.8	1,363.9	809.6	1,009.6	1,094.0
Europe	2,716.4	3,709.4	2,443.2	2,702.9	68.1	57.5	164.9	206.1	1,750.4	1,633.5	1,298.6	1,554.4
Japan	1,216.3	1639.0	951.3	1,158.3	32.5	30.9	83.3	122.0	814.9	752.3	231.0	392.5
Canada	302.6	311.9	223.8	208.6	5.5	4.7	9.2	12.0	153.3	133.3	63.8	104.4
Australia	112.1	250.4	102.1	128.4	3.9	3.4	4.0	4.3	121.0	100.4	63.3	68.2
Other	15.2	67.8	16.0	34.7	1.7	0.7	-	0.8	32.0	69.0	14.9	29.2
China	200.0	550.0	253.0[2]	386.0[2]	13.5	12.5	22.0	18.0	190.0	200.0	180.0	210.0
Other Africa	58.0	77.7	51.4	89.9	2.2	2.1	-	-	62.1	84.1	25.8	52.6
Other	42.6	128.9	10.7	84.5	0.5	1.3	-	-	23.6	38.4	-	16.1
World Total	11,800.8	15,311.8	7,950.8	9,385.1	235.4	222.9	566.1	716.9	6,263.6	6,131.2	4,179.9	5,348.3

Source: Constructed on the basis of statistical information from Monthly World Metal Statistics published by World Bureau of Metal Statistics.

1/ Contains ferro-nickel, nickel oxide and fonte.
2/ Includes production of other area.
3/ Includes other Africa.
4/ Year 1973.

Table 13. Structure of the consumption of non-ferrous metals by country groups

(Percentage)

	Primary Aluminium		Refined Copper		Refined Tin		Refined Nickel		Slab Zinc		Refined Lead	
	1972	1980	1972	1980	1972	1980	1972 1/	1980	1972	1980	1972	1980
Developing Countries	6.4	9.2	5.5	8.9	7.6	10.3	2.3	5.7	8.8	13.4	9.1	11.3
Latin America	2.7	3.9	3.2	5.3	2.9	4.9	0.9	2.4	3.8	5.6	4.8	5.0
Asia	2.6	3.6	1.1	2.0	3.8	4.2	0.5	2.3	3.6	5.6	2.4	3.2
Africa	0.3	0.6	0.2	0.3	0.6	0.7	0.7	0.8	0.4	1.0	0.6	0.7
Oceania	-	-	-	-	-	-	-	-	-	-	-	-
Other	0.8	1.1	1.0	1.3	0.3	0.5	0.2	0.2	1.0	1.2	1.3	2.4
Centrally Planned Economies	17.7	17.7	18.0	20.1	14.1	18.1	22.1	23.8	19.2	24.3	21.8	22.9
USSR	12.2	12.1	13.0	13.8	7.6	11.0	17.7	18.4	13.4	16.8	13.4	15.0
Europe	5.5	5.6	5.0	6.3	6.5	7.1	4.4	5.4	5.8	7.5	8.4	7.9
Developed Market Economies	73.4	68.2	72.5	65.0	71.5	64.5	71.7	67.9	67.6	57.1	64.1	60.6
USA	36.4	29.1	25.5	19.9	24.0	20.9	25.5	19.8	21.8	13.2	24.2	20.5
Europe	23.0	24.2	30.7	28.8	28.9	25.8	29.1	28.7	27.9	26.6	31.1	29.1
Japan	10.4	10.7	12.0	12.3	13.8	13.9	14.7	17.0	13.0	12.3	5.5	7.3
Canada	2.6	2.0	2.8	2.2	2.3	2.1	1.6	1.7	2.5	2.3	1.5	2.0
Australia	0.9	1.6	1.3	1.4	1.7	1.5	0.8	0.7	1.9	1.6	1.5	1.3
Other	0.1	0.4	0.2	0.4	0.8	0.3	-	-	0.5	1.1	0.3	0.4
China	1.6	3.6	3.3	4.1	5.7	5.6	3.9	2.6	3.0	3.3	4.3	3.9
Other Africa	0.5	0.5	0.6	1.0	0.9	0.9	-	-	1.0	1.4	0.7	1.0
Other	0.4	0.8	0.1	0.9	0.2	0.6	-	-	0.4	0.5	-	0.3
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Table 12.

1/ Year 1973.

Table 14. Processing output of non-ferrous metals (Thousand tonnes)

	Production of Primary Aluminium		Production of Refined Copper		Production of Refined Tin		Production of Refined Nickel		Production of Slab Zinc		Production of Refined Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980
Developing Countries	716.4	1,708.1	1,581.4	2,177.5	145.8	172.9	75.1	113.7	530.7	751.6	556.8	732.0
Latin America	203.1	816.4	592.4	1,182.6	11.7	27.9	37.8	38.9	203.1	326.2	329.1	380.1
Asia	263.5	379.6	25.6	103.2	125.4	141.1	-	27.1	155.7	234.3	84.1	130.4
Africa	177.1	350.7	833.4	760.4	8.7	3.9	-	15.1	123.2	106.6	56.1	78.6
Oceania	-	-	-	-	-	-	37.3	32.6	-	-	-	-
Other	72.7	161.4	130.0	131.3	-	-	-	-	48.7	84.5	87.5	142.9
Centrally Planned Economies	2,288.4	2,909.9	1,513.1	2,033.0	13.2	19.0	133.4	176.1	1,201.9	1,430.6	863.5	1,083.1
USSR	1,900.0	2,400.0	1,225.0	1,450.0	12.0	17.0	130.0	165.0	820.0	1,060.0	600.0	780.0
Europe	388.4	509.9	288.1	583.0	1.2	2.0	3.4	11.1	381.9	370.6	263.5	303.1
Developed Market Economies	8,402.8	10,910.2	4,695.4	4,697.9	51.4	35.5	362.6	423.3	3,655.0	3,740.4	2,481.2	3,339.2
USA	3,739.8	4,653.6	2,048.9	1,686.0	4.4	4.7	14.3	40.1	641.3	369.9	760.9	1,150.5
Europe	2,442.2	3,597.3	1,149.8	1,291.2	38.1	24.0	105.3	93.3	1,424.8	1,730.1	1,099.0	1,409.3
Japan	1,009.1	1,091.5	810.0	1,014.3	1.5	1.3	79.3	109.3	809.0	735.2	223.2	304.9
Canada	918.2	1,074.5	495.9	505.2	-	0.2	149.2	149.3	476.2	991.6	184.9	231.0
Australia	205.8	303.5	173.7	182.4	7.4	5.3	16.5	35.3	303.7	301.0	208.8	233.7
Other	87.7	189.8	17.1	18.8	-	-	-	-	-	12.6	2.4	9.8
China	155.0	358.0 1/	195.0 1/	314.0 1/	23.0	15.0	-	11.0	120.0	155.0	125.0	175.0
Other Africa	52.9	86.6	102.9	147.9	1.6	2.2	20.0	18.1	47.2	81.4	64.7	78.1
Other	32.1	62.5	4.8	19.5	-	-	6.2	0.6	-	-	-	16.8
World Total	11,647.6	16,035.3	8,092.6	9,389.8	235.0	244.6	597.3	742.8	5,554.8	6,159.0	4,091.2	5,424.2

Source: Based on World Metal Statistics.

1/ Includes other Asia.

Table 15. Structure of the processing output of non-ferrous metals by country groups

(Percentage)

	Production of Primary Aluminium		Production of Refined Copper		Production of Refined Tin		Production of Smelter Refined Nickel		Production of Slab Zinc		Production of Refined Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980
Developing Countries	6.2	10.7	19.5	23.2	62.0	70.7	12.6	15.3	9.6	12.2	13.6	13.5
Latin America	1.7	5.1	7.3	12.6	5.0	11.4	6.3	5.2	3.7	5.3	8.0	7.0
Asia	2.3	2.4	0.3	1.1	53.4	57.7	-	3.6	2.8	3.8	2.1	2.4
Africa	1.6	2.2	10.3	8.1	3.6	1.6	-	2.1	2.2	1.7	1.4	1.4
Oceania	-	-	-	-	-	-	6.3	4.4	-	-	-	-
Other	0.6	1.0	1.6	1.4	-	-	-	-	0.9	1.4	2.1	2.6
Centrally Planned Economies	19.6	18.1	18.7	21.7	5.6	7.8	22.3	23.7	21.6	23.2	21.1	20.0
USSR	16.3	15.0	15.1	15.5	5.1	7.0	21.8	22.2	14.8	17.2	14.7	14.4
Europe	3.3	3.1	3.6	6.2	0.5	0.8	0.5	1.5	6.8	6.0	6.4	5.6
Developed Market Economies	72.1	68.1	58.0	50.0	21.9	14.5	60.7	57.0	65.8	60.7	60.6	61.6
USA	32.0	29.0	25.3	18.0	1.9	1.9	2.4	5.4	11.5	6.0	18.6	21.2
Europe	21.0	22.4	14.2	13.8	16.3	9.8	17.6	12.6	25.6	28.1	26.8	26.0
Japan	8.7	6.8	10.0	10.7	0.6	0.5	13.3	14.7	14.6	11.9	5.5	5.6
Canada	7.9	6.7	6.1	5.4	-	0.1	24.6	19.6	8.6	9.6	4.6	4.3
Australia	1.8	1.9	2.1	1.9	3.1	2.2	2.8	4.7	5.5	4.9	5.1	4.3
Other	0.7	1.3	0.2	0.2	-	-	-	-	-	0.2	-	0.2
China	1.3	2.2	2.4	3.3	9.8	6.1	-	1.5	2.2	2.5	3.0	3.2
Other Africa	0.5	0.5	1.3	1.6	0.7	0.9	3.3	2.4	0.8	1.4	1.7	1.4
Other	0.3	0.4	0.1	0.2	-	-	1.1	0.1	-	-	-	0.3
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Table 14.

The developed market economies have a large share of total world exports; however, their share of total world imports is even greater. In 1982 the developed market economies accounted for more than 70 per cent of total exports of zinc, aluminium and lead[176/] and 66.2 per cent of nickel. They had a lower share of copper, with 30.3 per cent, and only 11.6 per cent of tin. Their share of imports of all metals in 1982 was more than 75 per cent, with the exception of zinc which was 63.6 per cent[177/].

The centrally planned economies participate with a relatively low share of both exports and imports of processed metals. Their share of total world exports varies from 10.7 per cent in the case of nickel to 1.9 per cent in tin[178/]. Their share of imports is larger but does not exceed 15 per cent of total world imports of the different metals[179/]. Tables 16 through 19 show the amounts of exports and imports and the shares accounted for by the different groups of countries.

5. Relation between production and consumption

In developing countries, despite the great vulnerability of the non-ferrous metals industries to external factors, the ratio of self-sufficiency[180/], which measures the relation between their production and consumption, is relatively high. This apparent paradox is due to the fact that, in the specific case of the developing countries, the ratio of self-sufficiency does not express a strategy of development oriented mainly towards satisfying the internal needs of the industries and sectors that are the main users, but is the result of export-oriented development. This is reflected in their low share in total world consumption and their high share in total world exports.

176/ Their participation in 1982 in total world exports was 79.3 per cent of zinc, 72.4 per cent of aluminium, and 72.3 per cent of lead.

177/ Their participation in 1982 in the total imports was 94.9 per cent of tin, 92.1 per cent of nickel, 87.2 per cent of aluminium, 83.8 per cent of copper and 76.5 per cent of lead.

178/ The participation of the centrally planned economies in 1982 in total world exports of aluminium was 6.7 per cent, copper 5.6 per cent, zinc 3.8 per cent, and lead 2.6 per cent.

179/ The centrally planned economies in 1982 accounted for 9.5 per cent of world imports of lead, 14.3 per cent of zinc, 4.2 per cent of copper, and 5.1 per cent of aluminium.

180/ The ratio of production to consumption is defined as a relation that measures self-sufficiency; however, it does not necessarily reflect the domestic control that countries have over the different industries.

Table 16. Exports of non-ferrous metals (Thousands of tonnes)

	Primary Aluminium		Refined Copper		Refined Tin		Smelter Refinery Nickel 1/		Slab Zinc		Refined Lead	
	1972	1982	1972	1982	1972 3/	1982	1972 4/	1982	1972	1982	1972	1982
Developing Countries	327.4	1001.1	1361.3	1778.5	148.7	139.2	21.9	59.4	245.9	310.2	223.4	219.0
Latin America	60.4	343.4	433.4	1012.6	15.5	17.1	3.6	5.3	98.5	183.9	146.7	123.3
Asia	68.1	337.1	-	-	130.0	120.0	18.6	15.3	-	8.3	-	-
Africa	168.1	229.6	837.6	758.6	3.2	2.1	-	12.0	125.8	95.6	38.5	77.9
Oceania	-	-	-	-	-	-	-	26.8	-	-	-	-
Other	30.8	91.0	90.3	7.3	-	-	-	-	21.6	22.4	38.2	17.8
Centrally Planned Economies 1/	455.4	327.0 2/	-	162.0	5.5	3.1	18.8	36.4	241.9	69.5	106.7	26.9
Developed Market Economies	2,246.0	3,520.5	1,011.0	873.2	21.0	18.7	211.2	224.4	1,199.6	1,457.2	540.0	737.5
USA	100.8	364.1	165.7	31.6	4.7	9.4	15.0	31.2	3.9	0.7	4.7	51.2
Europe	1,278.3	1,927.4	467.7	520.1	14.2	8.6	73.6	83.2	512.6	713.4	261.6	337.9
Japan	8.7	6.7	25.5	44.6	-	-	3.0	4.8	106.6	40.8	4.7	7.5
Canada	698.7	896.4	293.4	232.6	-	-	105.7	73.7	370.4	470.4	127.8	146.1
Australia	94.5	185.6	58.7	44.3	2.1	0.7	13.9	31.5	206.1	231.9	141.2	194.8
Other	65.0	140.3	-	-	-	-	-	-	-	-	-	
Other Africa	0.3	16.0	28.6	66.4	-	-	23.9	13.0	-	0.5	40.3	22.5
Other	1.3	0.6	-	-	-	-	5.5	5.8	-	-	-	14.8
World Total	3,030.4	4,865.2	2,400.9	2,880.1	175.2	161.0	281.3	339.0	1,687.4	1,837.4	910.4	1,020.7

Source: Based mainly on World Metal Statistics.

1/ Includes central planned economies of the Third World and China.
2/ Includes secondary aluminium.
3/ The exports are of the year 1974.
4/ The exports are of the year 1978, and were estimated on the basis of Tables 49 and 51 of the study "The Economics of Nickel".

Table 17. Structure of exports of non-ferrous metals by country groups

(Percentage)

	Primary Aluminium		Refined Copper		Refined Tin		Smelter Refinery Nickel		Slab Zinc		Refined Lead	
	1972	1982	1972	1982	1972 3/	1982	1972 4/	1982	1972	1982	1972	1982
Developing Countries	10.8	20.6	56.7	61.8	84.9	86.5	7.8	17.5	14.6	16.9	24.5	21.5
Latin America	2.0	7.1	18.1	35.2	8.8	10.6	1.3	1.6	5.8	10.0	16.1	12.1
Asia	2.2	6.9	-	-	74.3	74.5	6.5	4.5	-	0.5	-	-
Africa	5.5	4.7	34.9	26.3	1.8	1.4	-	3.5	7.5	5.2	4.2	7.6
Oceania	-	-	-	-	-	-	-	7.9	-	-	-	-
Other	1.1	1.9	3.7	0.3	-	-	-	-	1.3	1.2	4.2	1.8
Centrally Planned Economies 1/	15.1	6.7	-	5.6	3.1	1.9	6.7	10.7	14.3	3.8	11.7	2.6
Developed Market Economies	74.1	72.4	42.1	30.3	12.0	11.6	75.1	66.2	71.1	79.3	59.3	72.3
USA	3.3	7.6	6.9	1.1	2.7	5.8	5.3	9.2	0.2	-	0.5	5.0
Europe	42.2	39.6	19.5	18.1	8.1	5.4	26.2	24.5	30.4	38.8	28.7	33.1
Japan	0.3	0.1	1.1	1.5	-	-	1.1	1.4	6.3	2.2	0.5	0.7
Canada	23.1	18.4	12.2	8.1	-	-	37.6	21.7	22.0	25.6	14.0	14.3
Australia	3.1	3.8	2.4	1.5	1.2	0.4	4.9	9.4	12.2	12.7	15.6	19.2
Other	2.1	2.9	-	-	-	-	-	-	-	-	-	
Other Africa	-	0.3	1.2	2.3	-	-	8.5	3.8	-	-	4.5	2.2
Other	-	-	-	-	-	-	1.9	1.8	-	-	-	1.4
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Table 16.

Table 18. Imports of non-ferrous metals (Thousands of tonnes)

	Primary Aluminium		Refined Copper		Refined Tin 4/		Smelter Refinery Nickel		Slab Zinc		Refined Lead	
	1972	1982	1972	1982	1972 5/	1982	1972 6/	1982	1972	1982	1972	1982
Developing Countries	152.4	271.4	187.5	314.8	6.0	4.6	12.4	9.2	86.5	313.5	44.0	101.5
Latin America	105.2	40.4	84.8	204.7	-	-	3.0	2.1	-	27.4	-	3.4
Asia	1.3	199.6	53.1	86.8	6.0	4.6	9.3	6.0	62.8	272.4	39.2	82.5
Africa	-	-	-	-	-	-	-	-	-	-	-	-
Oceania	-	-	-	-	-	-	-	-	-	-	-	-
Other	45.9	31.4	49.6	23.3	-	-	0.1	1.1	23.7	13.7	4.8	15.6
Centrally Planned Economies 1/	-	240.9 2/	-	120.8 3/	-	-	-	2.3	48.6	235.4 8/	59.8	77.1
Developed Market Economies	2,385.6	4,078.0	2,238.7	2,395.0	127.7	98.2	251.0	276.5	1,106.0	1,045.1	674.8	623.4
USA	588.5	614.7	172.3	284.8	46.8	27.9	136.3 7/	81.6	474.1	447.3	219.9	91.2
Europe	1,436.9	1,978.4	1,876.8	1,786.4	47.5	40.7	102.7	163.8	612.6	543.0	440.1	458.9
Japan	324.7	1,446.6	173.4	295.8	28.6	26.2	10.6	28.5	8.0	44.3	4.3	61.3
Canada	34.7	24.4	16.2	28.0	4.8	3.2	1.4	2.6	11.3	0.7	10.5	5.7
Australia	0.8	13.9	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	0.2	0.2	-	-	-	9.8	-	6.3
Other Africa	1.1	-	6.5	-	-	-	-	-	6.7	4.6	9.8	4.4
Other	6.3	88.6	13.6	26.5	3.2	0.7	2.4	12.3	-	45.4	-	8.8
World Total	2,545.4	4,678.9	2,446.3	2,857.1	136.9	103.5	265.8	300.3	1,247.8	1,644.0	788.4	8..2

Source: Based mainly on World Metal Statistics.

1/ Includes Central planned economies of the Third World and China.
2/ China imported 169.6 thousand metric tonnes. Includes secondary aluminium.
3/ China imported 120.8 thousand metric tonnes.
4/ Does not included centrally planned economies.
5/ Year 1978.
6/ Year 1978, based on Tables 49 and 51 of "The Economics of Nickel."
7/ Includes nickel alloys.
8/ China imported 108.1 thousand metric tonnes.

Table 19. Structure of imports of non-ferrous metals by country groups

(Percentage)

	Primary Aluminium		Refined Copper		Refined Tin		Smelter Refinery Nickel		Slab Zinc		Refined Lead	
	1972	1982	1972	1982	1972	1982	1972	1982	1972	1982	1972	1982
Developing Countries	5.9	5.8	7.7	11.0	4.4	4.4	4.7	3.1	6.9	19.1	5.6	12.5
Latin America	4.1	0.9	3.5	7.2	-	-	1.1	0.7	-	1.7	-	0.4
Asia	0.1	4.3	2.2	3.0	4.4	4.4	3.6	2.0	5.0	16.6	5.0	10.2
Africa	-	-	-	-	-	-	-	-	-	-	-	-
Oceania	-	-	-	-	-	-	-	-	-	-	-	-
Other	1.7	0.6	2.0	0.8	-	-	-	0.4	1.9	0.8	0.6	1.9
Centrally Planned Economies	-	5.1	-	4.2	-	-	-	0.8	3.9	14.3	7.6	9.5
Developed Market Economies	93.7	87.2	91.5	83.8	93.3	94.9	94.4	92.1	88.6	63.6	85.6	76.5
USA	23.1	13.1	7.0	10.0	34.2	27.0	51.3	27.2	38.0	27.2	27.9	11.2
Europe	56.4	42.3	76.7	62.5	34.7	39.3	38.6	54.5	49.1	33.0	55.8	56.3
Japan	12.8	30.9	7.1	10.4	20.9	25.3	4.0	9.5	0.6	2.7	0.6	7.5
Canada	1.4	0.6	0.7	0.9	3.5	3.1	0.5	0.9	0.9	-	1.3	0.7
Australia	-	0.3	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	0.2	-	-	-	0.7	-	0.8
Other Africa	-	-	0.3	-	-	-	-	-	0.6	0.3	1.2	0.5
Other	0.4	1.9	0.5	1.0	2.3	0.7	0.9	4.0	-	2.7	-	1.0
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Table 18.

The highest ratio of self-sufficiency of the developing countries in 1980 was in tin, where their production was 7.5 times their consumption. The lowest ratio was in zinc, where the production covered only 92 per cent of the consumption[181/].

The developed market economies are able to meet their consumption needs through their own production in slab zinc, primary aluminium, and refined lead. The ratio of self-sufficiency in these non-ferrous metals industries in 1980 was 106.9 for zinc, 104.6 for primary aluminium, and 102.9 for refined lead. In the other non-ferrous metals industries their production does not cover their consumption, and they have to import from the developing countries. Thus for refined nickel, their self-sufficiency ratio in 1980 was 86.9 per cent, in refined copper 77 per cent and in tin 24.7 per cent.

The centrally planned economies, which direct their production mainly towards covering their own needs, have a relatively balanced relation between production and consumption for most of the metals except tin, where the ratio of self-sufficiency is only 47 per cent. In the cases of copper, aluminium and nickel, production is slightly higher than consumption, and in zinc and lead, it is relatively smaller[182/]. Table 20 presents the self-sufficiency ratios of the various groups of countries.

6. Relation between exports and production

The share of exports in production of the non-ferreous metals under study is generally higher in the developing countries than in the developed market and centrally planned economies, reflecting the more externally oriented development of the non-ferrous metal industries of developing countries. The smaller shares in the centrally planned economies reflect the tendency of those countries to orient their production mainly towards meeting the needs of their internal market.

181/ The self-sufficiency ratios in the other non-ferrous metals in 1980 were 276.6 in refined nickel, 260.4 in refined copper, 121.1 in refined lead and 120.9 in primary aluminium.

182/ The self-sufficiency ratios in the centrally planned economies in 1982 were the following: copper, 107.7, aluminium, 107.3, nickel, 103.1, zinc, 95.9, lead, 88.6 and tin, 47.

Table 20. Self-sufficiency[1/] in non-ferrous metals (Percentage)

	Primary Aluminium		Refined Copper		Refined Tin		Smelter Refinery Nickel		Slab Zinc		Refined Lead	
	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980	1972	1980
Developing Countries	94.8	120.9	359.9	260.4	814.5	751.7	582.2	276.6	96.2	91.8	146.6	121.1
Latin America	62.8	136.5	230.3	238.6	172.1	253.6	771.4	230.2	84.5	94.8	163.9	142.2
Asia	85.4	68.6	30.4	53.7	1,408.9	1,501.1	-	165.2	69.5	68.3	83.3	77.2
Africa	513.3	376.3	5,593.3	2,935.9	621.4	243.8	-	247.5	492.8	181.9	243.9	196.5
Oceania	-	-	-	-	-	-	-	-	-	-	-	-
Other	81.9	95.9	156.3	107.1	40.0	47.0	-	-	77.9	115.8	159.1	111.4
Centrally Planned Economies	109.8	107.3	105.8	107.7	40.0	47.0	106.5	103.1	100.1	95.9	94.6	88.6
USSR	131.5	129.7	118.9	111.5	66.6	69.4	130.0	125.0	97.6	102.9	107.1	97.5
Europe	60.8	59.2	72.0	99.2	8.0	12.7	13.4	28.6	105.9	80.2	74.6	71.8
Developed Market Economies	97.0	104.6	81.4	77.0	30.5	24.7	89.3	86.9	86.3	106.9	92.5	102.9
USA	87.0	80.8	100.9	90.3	7.8	10.1	9.9	28.3	47.0	45.7	75.4	105.2
Europe	89.9	97.0	47.1	47.8	55.9	41.7	63.9	45.3	81.4	105.9	84.6	90.6
Japan	83.0	66.6	85.1	87.6	4.6	4.2	95.2	89.6	99.2	97.7	96.6	77.7
Canada	303.4	344.5	221.6	242.2	-	4.2	1,600.0	1,210.0	310.6	443.8	292.9	221.3
Australia	183.6	121.2	170.1	142.1	189.7	155.9	412.5	820.9	250.9	299.8	329.9	342.7
Other	576.9	279.9	106.9	54.2	-	-	-	-	-	18.3	16.1	33.6
China	77.5	34.5	77.0	81.3	170.4	120.0	-	101.0	63.2	77.5	69.4	83.3
Other Africa	91.2	111.5	200.2	164.5	72.7	104.8	-	-	76.0	96.8	250.8	148.5
Other	75.4	48.5	44.9	23.1	-	-	-	-	-	-	-	104.3

Source: Based on information of Tables 12 and 14.

1/ Self-sufficiency = $\frac{\text{Production}}{\text{Consumption}} \times 100\%$.

Table 21. Share of Exports in Processing Output, 1982

(Percentage)

	Primary Aluminium	Refined Copper	Refined Tin	Smelter Refinery Nickel	Slab Zinc	Refined Lead
Developing Countries	52.0	78.8	89.2	83.4	39.3	35.6
Latin America	43.1	84.6	58.8	44.5	44.1	37.1
Asia	65.3	-	97.7	100.0	5.5	-
Africa	58.3	96.0	50.0	82.2	71.0	82.7
Oceania	-	-	-	95.7	-	-
Other	41.3	5.8	-	-	25.8	15.1
Centrally Planned Economies	10.1	6.7	-	15.6	4.2	2.0
Developed Market Economies	40.5	18.6	60.3	75.1	42.3	33.5
USA	11.1	1.9	261.0	76.5	0.2	5.0
Europe	58.3	37.2	38.6	140.0	43.0	92.0
Japan	1.9	4.1	-	5.5	6.2	2.5
Canada	83.8	68.9	-	113.0	91.9	61.2
Australia	48.7	24.9	-	68.6	78.5	77.2
Other	44.5	-	-	-	-	-
Other Africa	14.9	46.6	-	75.1	0.6	31.7
Other	5.9	-	-	-	-	42.3
World Total	34.8	30.1	78.4	54.7	30.8	23.9

Source: Based on Tables 14 and 16.

In the developing countries, the share of total production that is exported varies from 89.2 per cent of tin to 35.6 per cent of lead[183/]. In the developed market economies the share varies from 75.1 per cent of nickel to 18.6 per cent of copper[184/]. The ratio of exports to production in the centrally planned economies is very low. The metal with the largest share of exports in production is nickel, where exports represents 15.6 per cent of total production. The shares for other metals are: 10.1 per cent of aluminium, 6.7 per cent of copper, 4.2 per cent of zinc and 2 per cent of lead[185/]. Table 21 presents the share of exports in total production by the different groups of countries.

7. Degree of concentration and structure of ownership

In aluminium, six major TNCs[186/] accounted for approximately 57.8 per cent of the total market economy bauxite production and the twelve biggest enterprises accounted for 76.3 per cent. Among these enterprises are three state enterprises that produce approximately 9.3 per cent of world production[187/]. Table 22 shows the percentage shares in production of the major producers of bauxite, by company. The six major transnational corporations accounted for 41.3 per cent of world smelter production of aluminium[188/]. Government-owned enterprises also participate in smelter production. The developing country governments hold 5.6 per cent of the world capacity, the governments of developed centrally planned economies 21.2 per cent, and the governments of developed market economy countries 9 per cent. Developing country private investors have a share of only 2.2 per cent. Table 23 shows the shares of world capacity owned by the different agents.

183/ The share of exports in total production of the other metals is 83.4 per cent for nickel, 78.8 per cent for copper, 52 per cent for aluminium, 39.3 per cent for zinc, and 35.6 per cent for lead.

184/ The share of exports in production for tin is 60.3 per cent, for zinc 42.3 per cent, for aluminium 40.5 per cent, and for lead 33.5 per cent.

185/ In the case of tin, the share of exports in total production in China was 19.3 per cent in 1982.

186/ Alcoa, Kaiser, Alcan, Reynolds, Alusuisse, and Pechiney.

187/ Guyana Government (4.0%), P.T. Timah (1.3%) and Ergoinvest (3.5%).

188/ The other major TNCs owned 20.7 per cent of the world capacity.

In copper, 53.4 per cent of the total developed market economy mining production is accounted for by twelve enterprises, of which the major company is Codelco. This is a state enterprise that owns approximately 11.5 per cent of the total market economy mine capacity. The eight most important TNCs own 27.3 per cent of total market economy capacity and the four most important state enterprises of the developing countries have 26.1 per cent. Table 24 presents the participation of the most important companies in copper mining. In processing output capacity, the 15 major enterprises hold 73 per cent of total smelter capacity in the market economies and 63 per cent of refinery capacity. The twelve major TNCs contribute with 48.9 per cent of smelter capacity and 46.7 per cent of refinery capacity. The three major developing country state enterprises participate with 24.1 per cent of the smelter capacity and 16.3 per cent of the refinery capacity. Table 25 shows the concentration in copper smelter and refinery capacities.

In tin the three major mining enterprises are state companies. The major company is P.T. Timah (Indonesia) which produces 10 per cent of world output, followed by Comibol (Bolivia) with 9 per cent and the Malaysia Mining Corporation Bhd. (MMC) with 8.5 per cent. In 1980 P.T. Timah produced approximately 80 per cent of Indonesia's total tin mining output, processing most of it at Mintok smelter, its subsidiary. Comibol produced more than two-thirds of Bolivia's output of concentrates which is processed in two smelters that are operated by the state enterprise Empresa Nacional de Fundiciones (ENAF). MMC, which is 71.35 per cent owned by the Federal Government's holding company, holds interests in a large number of Malyasian companies which together accounted for around one-fourth of Malaysia's tin mining output[189/].

In tin processing, eight companies have approximately 88.9 per cent of the total world market economy tin smelting capacity: two major state enterprises of developing countries have 17.1 per cent (P.T. Timah, Comibol); the major private company from a developing country, which is from Malaysia, has 17.1 per cent; and the five major TNCs have 54.7 per cent. Table 26 shows the concentration in smelting.

189/ UNCTAD, "International Trade in Copper and Tin: Areas for Co-operation among State Trading Organizations of Developing Countries, February 1982, p.17.

Table 22. Concentration of world bauxite mining capacity

Company	Annual capacity[ab/] (millions of tonnes)	Share of world market economy capacity (Percentage)	(Cumulative percentage)
Alcoa	20.8	22.0	22.0
Kaiser	12.5	13.2	35.2
Alcan	6.4	6.8	42.0
Rio Tinto Zinc	6.2	6.6	48.6
Reynolds	5.7	6.0	54.6
Alusuisse	4.6	4.9	59.5
Pechiney	4.6	4.9	64.4
Guyana Government	4.0	4.2	68.6
Ergoinvest (Yugoslavia)	3.5	3.7	72.3
PT Timah (Indonesia)	1.3	1.4	73.7
Noranda	1.2	1.3	75.0
Martin Marietta	1.2	1.3	76.3

a/ Includes proportionate share of capacity in joint-venture projects.

b/ Capacity figures reflect equity ownership or control; actual disposal of bauxite may differ.

Source: Metal Bulletin Ltd., World Aluminium Survey 1977.

Table 23. Concentration of world aluminium smelter capacity, 1979
(Percentage)

Producer	Share of world capacity
Six major trans-national corporations	
Alcan	8.6
Alcoa	10.3
Alusuisse	3.7
Kaiser	6.3
Pechiney	6.0
Reynolds	6.4
Total	41.3
Other TNCs and private investors	
Europe	4.0
United States and Canada	7.1
Other	9.6
Total	20.7
Governments of developed market economy countries	9.0
Governments of developed centrally planned economies	21.2
Developing country governments	5.6
Developing country private investors	2.2
World, total	100.0

Source: "Transnational Corporations in the Bauxite/Aluminium Industry", New York, 1981.

Table 24. Concentration of world copper mining capacity, 1979[a/]
(Percentage)

Producer	Share of world market economy mine capacity
1. Codelco (Chile)	11.5
2. Gécamines (Zaire)	7.0
3. Zimco (Zambia)	5.6
4. Kennecott (United States)	4.9
5. Asarco (United States)	4.7
6. Phelps Dodge (United States)	4.5
7. Newmont (United States)	4.3
8. Anaconda (United States)	2.5
9. Anglo-American Group (South Africa)	2.2
10. Inco (Canada)	2.2
11. RTB Bor (Yugoslavia)	2.0
12. Rio Tinto Zinc (United Kingdom)	2.0
Total, above	53.4
Others	46.6
Total, market economies	100.0

Source: "Transnational Corporations in the Copper Industry." United Nations Centre on Transnational Corporations, New York, 1981.
a/ Including mines directly and indirectly owned and operated.

Table 25. Concentration of world copper smelter and refinery capacity, 1979
(Percentage)

Producer	Share of world market economy capacity (percentage)	
	Smelter Capacity	Refinery Capacity
1. Zimco (Zambia)	9.9	8.3
2. Asarco[1/] (United States)	9.9	7.7
3. Codelco-Chile (Chile)	7.9	5.4
4. Gécamines (Zaire)	6.3	2.6
5. Kennecott (United States)	5.5	5.9
6. Phelps Dodge (United States)	5.1	5.4
7. Nippon Mining (Japan)	5.1	4.8
8. Mitsubishi (Japan)	3.6	3.0
9. Anaconda (United States)	3.5	2.6
10. Enami (Chile)	3.1	1.7
11. Rio Tinto Zinc[2/] (United Kingdom)	2.8	2.6
12. Newmont (United States)	2.7	2.4
13. Noranda (Canada)	2.6	4.8
14. Norddeutsche Affineria[3/] (Federal Republic of Germany)	2.5	3.0
15. Amax (United States)	2.5	2.8
Total, above	73.0	63.0
Others	27.0	37.0
Total, market economies	100.0	100.0

Source: United Nations Industrial Development Organization: Mineral Processing in Developing countries (UNIDO/IOD.238, 1979) pp. 27-28.

1/ Including Mt. Isa Mines.
2/ Including Palabora.
3/ Owned by Metallgesellschaft AG, British Metals Corporation and Degussa.

Table 26. Concentration of world tin smelting capacity

Company	Annual Capacity (thousands of tonnes)	Share of world market economy capacity (percentage)	(cumulative percentage)
Patiño NV (Malaysia, Nigeria, Australia, Brazil)	69,500	29.6	29.6
Overseas Chinese Banking Group (Malaysia)	40,000	17.1	46.7
Shell-Billiton (Thailand)	25,000	10.7	57.4
Government of Indonesia - PT Timah	26,000	11.1	68.5
Rio Tinto Zinc-Copper Pass (UK)	20,000	8.5	77.0
COMIBOL (Bolivia)	14,000	6.0	83.0
Gulf Chemicals (US)	9,000	3.8	86.8
Metallurgie Hoboken-Overpelt (Belgium)	5,000	2.1	88.9

Source: Guide Minemet, 1977.

In nickel, eight companies account for 79 per cent of the world market economy mining capacity and 76.9 per cent of the processing capacity: two major state enterprises from developing countries have 9.3 per cent of mining capacity and 8.1 per cent of processing capacity and six major TNCs have 69.7 per cent of the mining and 68.8 per cent of the processing capacity. Table 27 shows the concentration of world mining and processing capacity in nickel.

A substantial proportion of total world mining and processing capacity in zinc in the market economies is owned or controlled by integrated producer groups, although this is not so pronounced as it is for aluminium or nickel. Approximately forty integrated firms account for 85 per cent of mining production and for 95 per cent of reduction capacity[190/]. Eleven major companies have 45.2 per cent of world capacity in zinc mining in the market economies. Centromin, a Peruvian State enterprise which is one of the eleven major companies, has 4.9 per cent of the world capacity. In zinc reduction, eleven major enterprises account for approximately 53.7 per cent of the world market economy capacity. In Europe, five corporate groups account for 80 per cent of all zinc reduction capacity, with state-owned firms in Finland, Yugoslavia, Italy, Austria and Spain making up the remainder. The largest producer is Société Générale de Belgique, which holds 40 per cent of European reduction capacity. The other major firms in the European industry include Rio Tinto Zinc, Metallgesellschaft, Preussag, and Imetal-Pennaroya. These five groups have a zinc reduction capacity exceeding their own mining production by approximately 900,000 tonnes per year[191/]. Tables 28 and 29 show the concentration in zinc mining and processing.

The degree of concentration in the lead industry is not extreme, although concentration is greater at the smelter-refinery stage than in mining production. No single firm or group has more than approximately 8 per cent of the total world market economy primary lead refining capacity, though the major thirteen account for 67.4 per cent of this capacity. The major developing country state enterprises are in Mexico (Penoles, Industria Minera Mexico) and account for approximately 10 per cent of the total capacity of the world market economies. Table 30 shows the company concentration in primary lead refining.

190/ UNIDO, "Mineral Processing in Developing Countries," December 1979, p. 69.
191/ Ibid. p. 69.

Table 27. Concentration of world mining and processing capacity in nickel, 1978 [a/]

Company	Annual Capacity thousands of tonnes	Share of world market mine capacity (percentage)	Share of world market mine capacity (cumulative percentage)
Mining			
INCO	264	33.5	33.5
SLN [b/]	111	14.1	47.6
Falconbridge	70	8.9	56.5
Western Mining	59	7.5	64.0
Cubaniquel	39	5.0	69.0
Marinduque	34	4.3	73.3
Freeport [c/]	27	3.4	76.7
Amax [d/]	18	2.3	79.0
Processing [e/]			
INCO	308	34.2	34.2
SLN [b/]	107	11.9	46.1
Falconbridge	75	8.3	54.4
Western Mining	54	6.0	60.4
Cubaniquel [f/]	39	4.3	64.7
Sumitomo [g/]	38	4.2	68.9
Amax [d/]	36	4.0	72.9
Marinduque	34	3.8	76.9

Source: United Nations Division of Natural Resources and Energy of the United Nations Secretariat.

a/ Excluding the centrally planned economies, except for Cuba.

b/ Including the operations of Larco (Greece) and Morro do Niquel (Brazil).

c/ Including the full capacity of Greenvale and Nepean (Australia), where Freeport is a 50-50 joint venture partner with Metals Exploration, Ltd.

d/ Including the full capacity of Selebi-Pikwe (Botswana).

e/ Company figures represent the capacity for producing marketable projects. Thus, for example, the Falconbridge smelter in Ontario, Canada, and the refinery in Norway are counted as a single processing unit.

f/ Part of the output is exported to the USSR in a slurry form that requires further processing; 18,000 tons per year is the current capacity for commercially marketable products.

g/ Including Hyuga Smelting.

Table 28. Company concentration in zinc mining

Company	Annual Capacity (thousands of tonnes)	Share of world market economy capacity (percentage)	Share of world market economy capacity (cumulative percentage)
Asarco/Mt. Isa Mines	399	6.8	6.8
Noranda	360	6.1	12.9
Texasgulf	310	5.3	18.2
Centromin Peru	285	4.9	23.1
Cominco	260	4.4	27.5
RTZ/CRA	220	3.8	31.3
Amax	188	3.2	34.5
Société Générale	175	3.0	37.5
St. Joe Minerals	165	2.8	40.3
Cyprus	150	2.6	42.9
Mitsui	136	2.3	45.2

Source: Guide Imetal; Energy Mines and Resources Canada, Zinc.

Table 29. Company concentration in zinc reduction

Company	Annual Capacity (thousands of tonnes)	Share of world market economy capacity (percentage)	Share of world market economy capacity (cumulative percentage)
Société Générale	687	12.2	12.2
Mitsui	312	5.5	17.7
Cominco	272	4.8	22.5
RTZ/CRA	265	4.7	27.2
Asarco/Mt. Isa	252	4.5	31.7
St. Joe Minerals	242	4.3	36.0
Imetal-Pennaroya	214	3.8	39.8
Metallgesellschaft	210	3.7	43.5
Noranda	204	3.6	47.1
EZ (Australia)	200	3.5	50.6
Anglo-American Group	177	3.1	53.7

Source: Guide Imetal; Energy Mines and Resources Canada, Zinc.

Table 30. Concentration of world primary lead refining capacity

Company	Annual Capacity (thousands of tonnes)	Share of world market economy capacity (percentage)	Share of world market economy capacity (cumulative percentage)
Asarco - Mt. Isa	263	7.7	7.7
Pennaroya	240	7.0	14.7
Broken Hill (Australia)	235	6.9	21.6
Amax	207	6.1	27.7
St. Joe Minerals	205	6.0	33.7
Penoles (Mexico)	180	5.3	39.0
Industria Minera Mexico	160	4.7	43.7
Cominco	154	4.5	48.2
Rio Tinto Zinc	150	4.4	52.6
Berzelius	140	4.1	56.7
Metallurgie Hoboken Overpelt	125	3.7	60.4
Preussag	120	3.5	63.9
Gulf Resources	118	3.5	67.4

Source: Guide Minimet; Metal Statistics 1977.

IV. RESTRUCTURING IN THE NON-FERROUS METALS INDUSTRIES

Developing countries have increased their participation in world production, consumption and trade of the the non-ferrous metals industries, despite decreases in direct investment by TNCs. This is due to the new forms presently taken by the process of internationalization of production, in which financial capital plays the major role, and also to the increased participation by the developing country state enterprises in the development of these industries. The developed market economies have generally decreased their shares in production, consumption and trade. The centrally planned economies have increased their share in world production and consumption; in respect of trade they have decreased their share in exports and increased it in imports.

The main changes that took place in the structure of the non-ferrous metals industries in the 1970s were the following:

1. Mining production

The developing countries generally increased their share in world mining output. The metals for which their share in total mining production increased most were copper and nickel, with increases of 4.9 per cent and 3.9 per cent respectively between 1972 and 1980. The share of the developing countries in tin increased by only 1.3 per cent; in zinc and lead their share was practically unchanged, and in bauxite their share decreased by 0.8 per cent.

The share of the developed market economies in mining output decreased in all the minerals under study, with the exception of bauxite, where it increased by 4.4 per cent. There were important decreases in the mining production of nickel and copper in these countries, 8.5 and 8.1 per cent respectively. The decrease in their mining production of zinc was 3.7 per cent, in lead 3.1 per cent, and in tin of 0.5 per cent.

The centrally planned economies increased their share in world mining output of almost all the minerals with the exception of bauxite, where they experienced a decrease of 4.6 per cent, and in lead, where their share remained stable.

2. Consumption

The developing countries increased their share in the consumption of processed metals between 1972 and 1980. The increases were generally higher than the percentage increments in the share of world mining production, except for copper and nickel, where the percentage increase was slightly lower. Their shares in total world consumption increased by 4.6 per cent for zinc, 3.4 per cent for both nickel and copper, 2.8 per cent for aluminium, 2.7 per cent for tin, and 2.2 per cent for lead.

The developed market economies decreased their share in the world consumption of all the metals studied here. The decrease in their share of aluminium consumption was 5.2 per cent, in contrast with their increased share in mining production. In zinc, tin and lead consumption, their shares decreased by a greater precentage than in mining output. In zinc their contribution decreased by 10.5 per cent, in tin by 7 per cent and in lead by 3.5 per cent. In nickel and copper consumption their shares decreased by less than in mining output. Their participation decreased by 3.8 per cent in nickel, and by 7.5 per cent in copper.

The centrally planned economies increased their share of world consumption of all the metals in the 1970s, except for aluminium, where their share remained the same. They increased their share in world consumption by more than their share in mining production for zinc, tin and lead. In zinc they increased their share in consumption by 5.1 per cent, in tin by 4 per cent, and in lead by 1.1 per cent. In nickel and in copper the increases in their share in consumption were relatively smaller than in mining output, 1.7 and 2.1 per cent respectively.

3. Processing output

In the 1970s the developing countries increased their share in world production of the processed metals under study, except for lead, where they had a slight decrease. The increases in their share of the processing output were higher than in their share of world consumption for aluminium, copper and tin, and smaller for the other metals. The increases were: 4.5 per cent for aluminium, 3.7 per cent for copper and 8.7 per cent for tin. In the other metals, the increases were 2.7 per cent for nickel, 2.6 per cent for zinc, and a slight decrease of 0.1 per cent for lead.

The developed market economies decreased their share in the world processing output of all the metals during this period, with the exception of lead, which had a slight increase of 1 per cent[192/]. Their percentage decrease was greater in production than in consumption for copper (8%) and tin (7.4%). For the other metals the decreases in the share of output processing were smaller: 4 per cent for aluminium, 3.7 per cent for nickel and 5.1 per cent for zinc.

The centrally planned economies had an increase in their share of the processing output in all the metals under study, except for aluminium and lead. The increase in their share of industrial production was higher than the increase in their share of consumption only in the case of copper[193/].

4. Exports and Imports

Between 1972 and 1982 the developing countries increased their share in world exports of all the metals except lead, where there was a slight decrease. Their share in world imports decreased for nickel and aluminium, remained the same for tin, increased somewhat for copper and increased considerably for zinc and lead[194/].

The developed market economies decreased their share in world exports, except for lead and zinc, where they had an increase. These countries also experienced a decrease in their share of world imports, except for tin, where they had a slight increase. The centrally planned economies decreased their share in world exports in all the metals except for copper, and increased their share in the imports of all metals.

192/ The developed market economies had a decrease in their share of world consumption.

193/ The increase of the centrally planned economies in world processing output was 3 per cent in copper, 2.2 per cent in tin, 1.4 per cent in nickel, 1.6 per cent in zinc. Their share in aluminium decreased by 1.5 per cent and in lead by 1.1 per cent.

194/ For further details see Tables 17 and 19.

5. Concentration

The concentration of the non-ferrous metals industries has decreased, as shown in the first chapter, lessening the importance of the oligopolistic barrier to entry into these industries for newcomers, which are mainly developing countries.

This decrease in the degree of concentration was mainly due to the reduction of the dominant role played in the 1950s by the enterprises of the United States and England, caused by the increasingly important role played by enterprises from Japan and Europe, and also by national enterprises in developing countries in the process of internationalization of production.

6. Changing Patterns of Investment and Ownership

There have been changes in the patterns of investment in the non-ferrous metals industries. Since approximately the end of the 1960s the major TNCs have reduced their direct investment in equity in the developing countries. There was a reduction of private equity from 88 or 90 per cent of the total capital in the period up to 1960 to about 33 per cent by the 1970s[195/]. The capital expenditures in mining and smelting by majority-owned foreign affiliates of U.S. companies in developing countries decreased from 38.6 per cent in 1970 to only 15.5 per cent in 1978 (see Table 31). An equally clear decrease can be seen from the changing geographical distribution of the United Kingdom's direct foreign investments in mining and quarrying (oil and gas excluded). In 1965, 36 per cent of the total of such investments were located in developing countries, while in 1976-1978, the proportion was no more than 6 per cent[196/].

195/ "The Nickel Industry and the Developing Countries", United Nations, New York, 1980.

196/ Radetzki, Marian "Has Political Risk Scared Mineral Investment away from the Deposits in Developing Countries?", World Development, Vol. 10, No.1, 1982, p. 40.

Table 31. Mining and smelting: Capital expenditures by majority-owned foreign affiliates of United States companies, 1970-1978

(Millions of 1967 dollars)[a/]

Year	In developing countries	In developed countries	Total	Share in developing countries (percentage)
1970	392	621	1013	38.6
1971	287	998	1285	22.3
1972	239	811	1050	22.8
1973	169	587	756	22.4
1974	197	477	674	29.2
1975	198	473	671	29.5
1976	123	363	486	25.3
1977	54	291	345	15.7
1978[b/]	51	278	329	15.5

Source: UNCTC, Transnational Corporation in the Bauxite/Aluminium Industry, New York, 1982.

a/ Deflated by United States wholesale price index, 1967 = 100.

b/ Projected.

This decrease in the direct equity involvement of foreign companies in new projects in the developing countries was due to economic and non-economic factors. In the period between 1973 and 1980 the OECD countries experienced a deceleration in industrial production and also in fixed investment[197/], which negatively affected both the levels of consumption of non-ferrous metals and the process of internationalization of their non-ferrous metal industries. Another reason for the relative reduction in direct investment in comparison to lending was that capital costs for new projects were growing beyond the internal cash generation and borrowing capacity of existing mining firms; this was especially true for big projects in developing countries where substantial investments were required for basic infrastructure.

The spread of new patterns of investment arrangements has been accelerated since the mid-1970s by the appearance of new sources of finance such as the transnational oil companies, governments of the oil-producing countries, insurance companies from western countries, and merchant finance and equipment-leasing schemes[198/]. Also, the rapid expansion of the Eurodollar market created a favourable climate for increased lending[199/].

The gradual decrease in the share in direct investment of the TNC's has also been caused by the increase of the national interest and ownership by developing countries in the mining and processing of non-ferrous minerals, which affects the foreign interest represented by the TNCs. The developing countries have increased their national control over the mining and processing of non-ferrous metals through various means, including the imposition of government controls, increasing taxation, the build-up of national competence, and the partial or complete nationalization of foreign equity, sometimes with compensation considered inadequate by the TNCs or in some cases without compensation[200/].

197/ Between 1973-1980 the increase of the GDP for the OECD countries was 2.6 per cent annually, compared with 5.2 per cent in the 1963-73 period. The decline in the industrial production was greater, 1.6 per cent against 5.8 per cent for the same periods. (UNCTAD, Trade and Development Report 1982, pp. 53, 57). The fixed investment of the United States, which had increased by 72.7 per cent during 1966-1973, grew by 38.2 per cent in 1974-1979 and 18.8 per cent between 1980 and 1982.

198/ For further detail see Radetzki and Zorn, "Financing Mining Projects", United Nations Study, London 1979.

199/ Ibid., p. 58.

200/ Radetzki, Marian "Has Political Risk Scared Mineral Investment away from the Deposits in Developing Countries?", loc. cit, pp. 42-43.

In addition to the increasing role taken by governments in the developing countries, there have been initiatives taken by the TNCs for conversion of fully foreign-owned subsidiaries into joint ventures with national enterprises. In the copper industry, Kennecott in Chile was the first company to adopt a joint-venture approach. In 1970 the Zambian Government took over 51 per cent of both the Anglo-American Corporation and the Roan Selection Trust mining interests. In 1976 Asarco sold out all its assets to the Mexican Government. The governments of the developing countries have also been increasing their participation in equity in new projects. In the Cerro Colorado project in Panama, for example, 60 per cent of the equity will remain in the hands of the Panamanian Government. At OK Tedi, in Papua New Guinea, no single foreign investor will hold more than 30 per cent[201/].

In the case of aluminium, to minimize risk, the TNCs have in some cases formed consortia, such as those in Guinea and Brazil, in which the partners take shares of the output proportional to their equity participation. Also in other cases TNCs have supplied only technology without participating in equity. One of the first cases of this kind was the Companhia Brasileira do Aluminio in Brazil, where the Government owned 20 per cent and the other 80 per cent was owned by private investors. The Soviet Union has also provided technical assistance for the establishment of aluminium industries, in several developing countries such as India, Egypt and Turkey[202/].

Finally, it should be noted that the empirical data show that the number and investment value of new projects under construction in developing countries are maintaining a relatively constant share of total projects. The Engineering and Mining Journal, which covers the expected investments in projects at advanced stages - mainly under the phase of implementation - showed that since 1964 developing countries have accounted for between 40 per cent and 50 per cent of the total number of projects reported as under construction, and for between 50 per cent and 60 per cent of the total amount of investment committed to such projects. In the 1984 Engineering and Mining Journal survey, of the $28 billion committed in construction funds more than half are to be invested in the developing countries. Thus there has not been a falling off in the total investment in mining and processing industries in developing countries.

201/ UNCTC, Transnational Corporations in the Copper Industry. New York, 1981.
202/ UNCTC, Transnational Corporation in the Bauxite/Aluminium Industry. New York, 1981.